

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

DIESEL PROGRESS



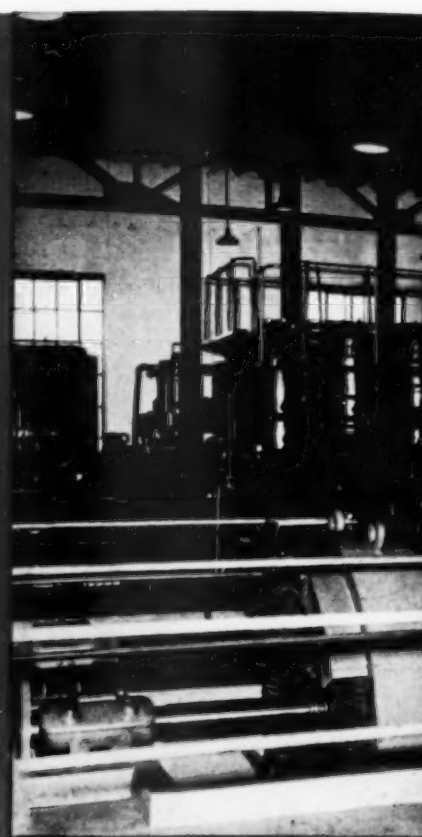
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JULY, 1954

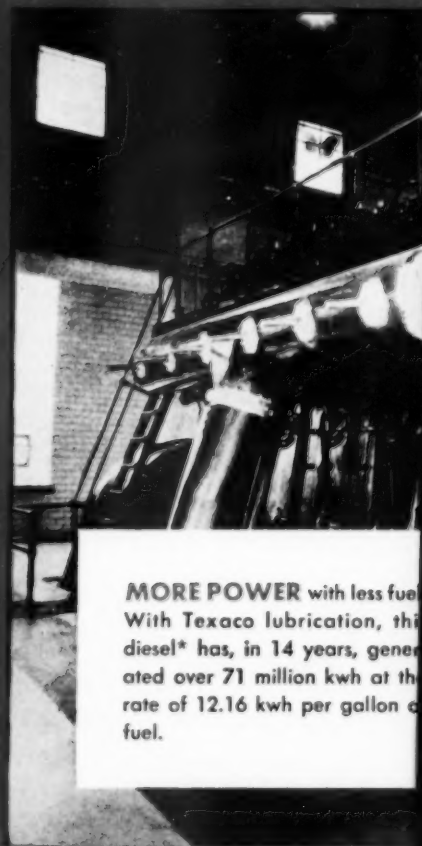
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GOOD REASONS WHY...

**FOR OVER 20 YEARS, MORE
STATIONARY DIESEL H.P. IN
THE U.S. HAS BEEN LUBRI-
CATED WITH TEXACO THAN
WITH ANY OTHER BRAND**



MINIMUM WEAR—less than .001" after 28,540 hours' operation—reports this Oklahoma drilling company.* *Texaco Urso* Oils protect engines in severest service.



MORE POWER with less fuel. With Texaco lubrication, this diesel* has, in 14 years, generated over 71 million kwh at the rate of 12.16 kwh per gallon of fuel.



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COSTS for both diesel and dual-fuel engines have been consistent throughout 20 years of Texaco lubrication in this South Dakota plant.*

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assured for all types and sizes of diesel, gas and dual-fuel engines, regardless of operating conditions or fuel used. Just use one of the famous *Texaco Ursa Oils* — a complete line especially refined to make engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

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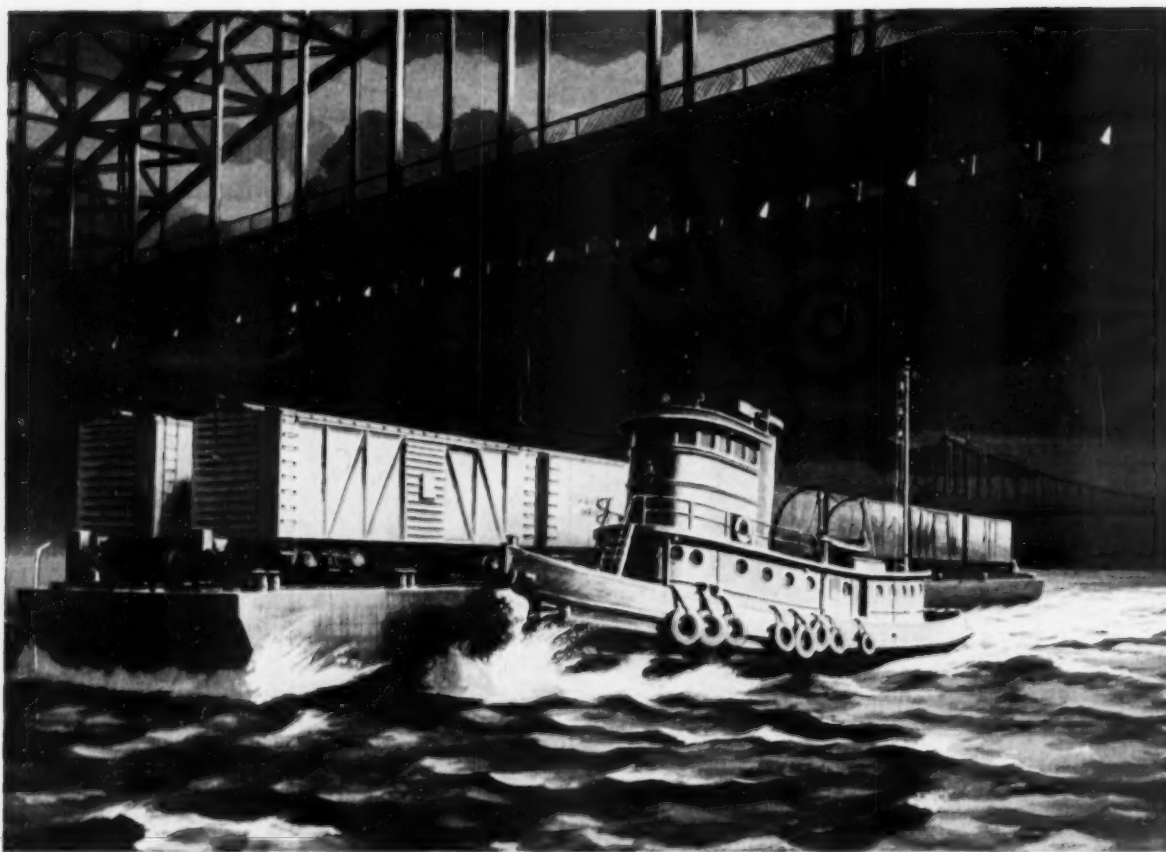
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* Name on request.

URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES



HELL GATE HATH NO FURY

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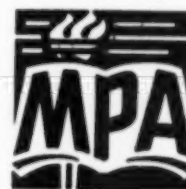


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FRONT COVER ILLUSTRATION

The U.S.S. *Endurance*,
new Navy minesweeper
powered by Packard ma-
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J. M. Martinac Shipbuild-
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ma, Washington. The ves-
sel is one of a new class
of ships in this Navy pro-
gram.

New

DE LAVAL TURBOCHARGER

*offers highest pressure
ratios and efficiencies*

De Laval Turbochargers for diesel engines utilize a radically new design principle.

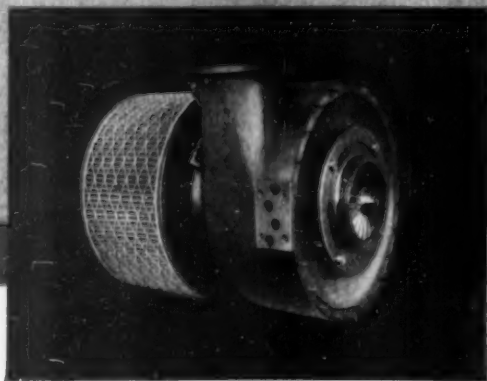
As a result of the Monorotor construction shown here, these De Laval units are capable of producing pressure ratios of 3:1 for continuous full-load operation of the engine and higher for engine

overload ratings. Compressor and turbine efficiencies are extremely high.

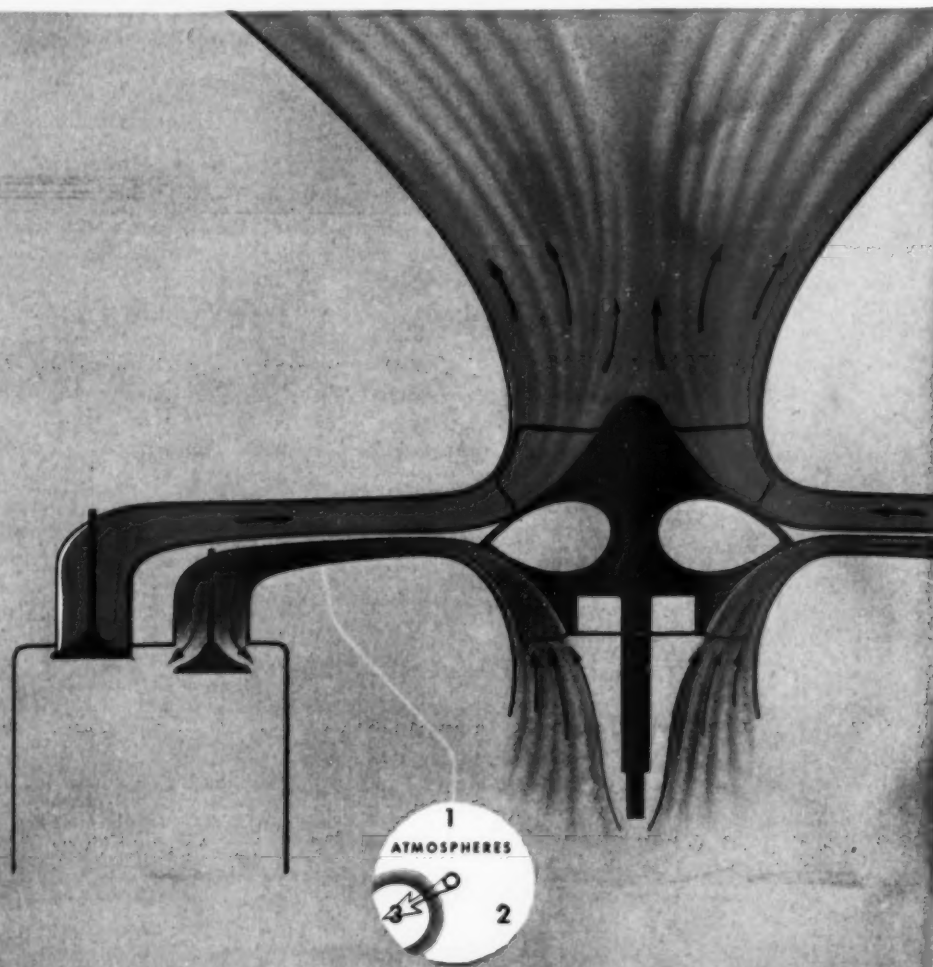
Other Monorotor advantages are exceptional simplicity, comparatively few parts and light weight, in spite of very rugged construction.

Write for specification data on your application.

- Rotor is constructed entirely of alloy steels.
- Turbine blades and turbine hub, made from a highly heat-resisting cobalt alloy, are an integral structure. This provides the highest possible safety factor.
- Turbine rotor is air-cooled, for safe operation with any temperature encountered in reciprocating engine service.
- Design of all flow passages minimizes possibility of clogging.
- Turbine nozzle box or turbine housing is not water-cooled. Thus there is only negligible heat rejection to engine cooling system.
- Turbine nozzle guide vanes are adjustable, for matching turbocharger to engine.
- Shaft end is free for driving lubricating system, tachometer and other accessories.



This is one of 4 sizes of De Laval B-Type Turbochargers

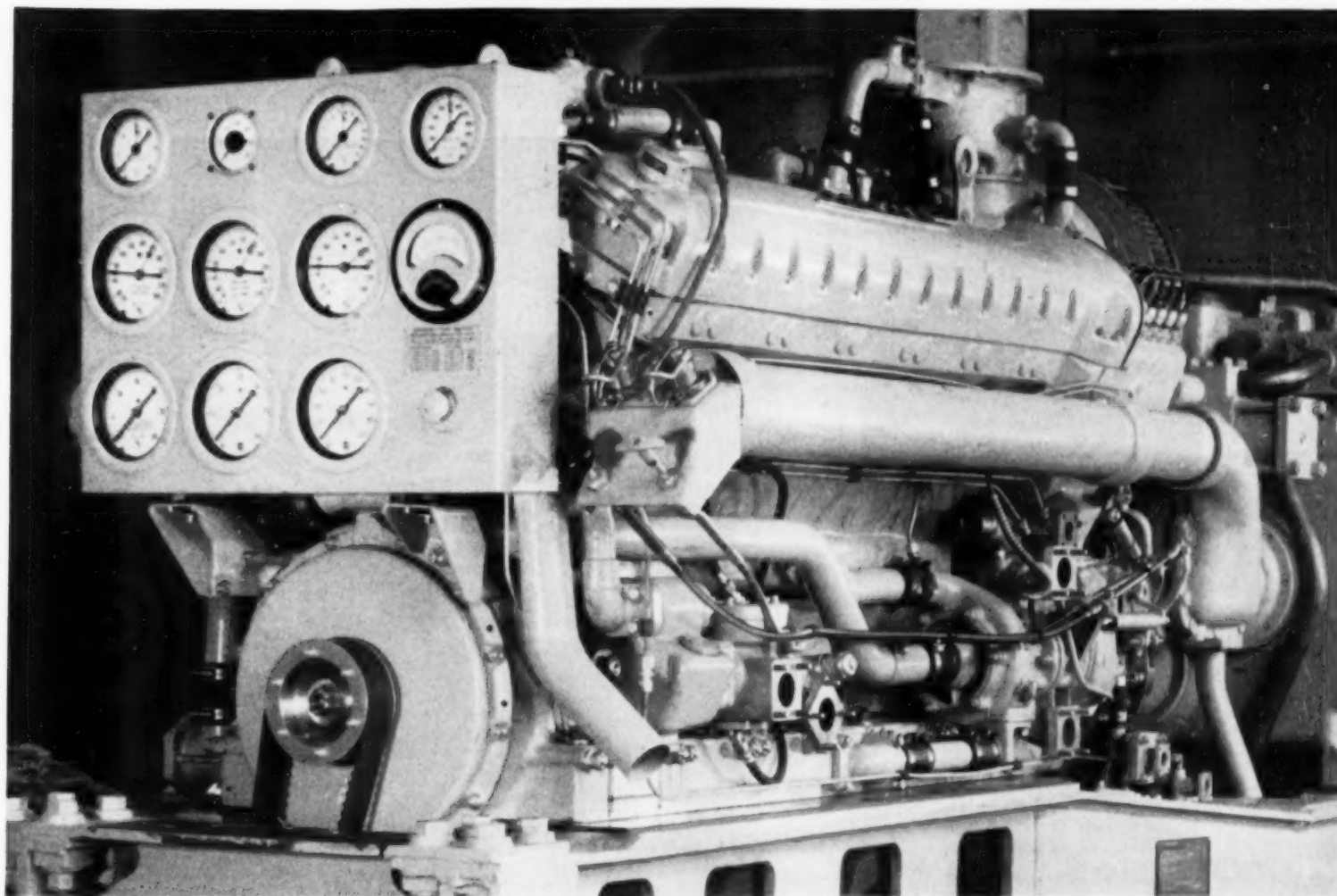


EXCLUSIVE MONOROTOR CONSTRUCTION



DE LAVAL Turbochargers

DE LAVAL STEAM TURBINE COMPANY
882 Nottingham Way, Trenton 2, New Jersey



U. S. S. ENDURANCE...POWERED BY PACKARD

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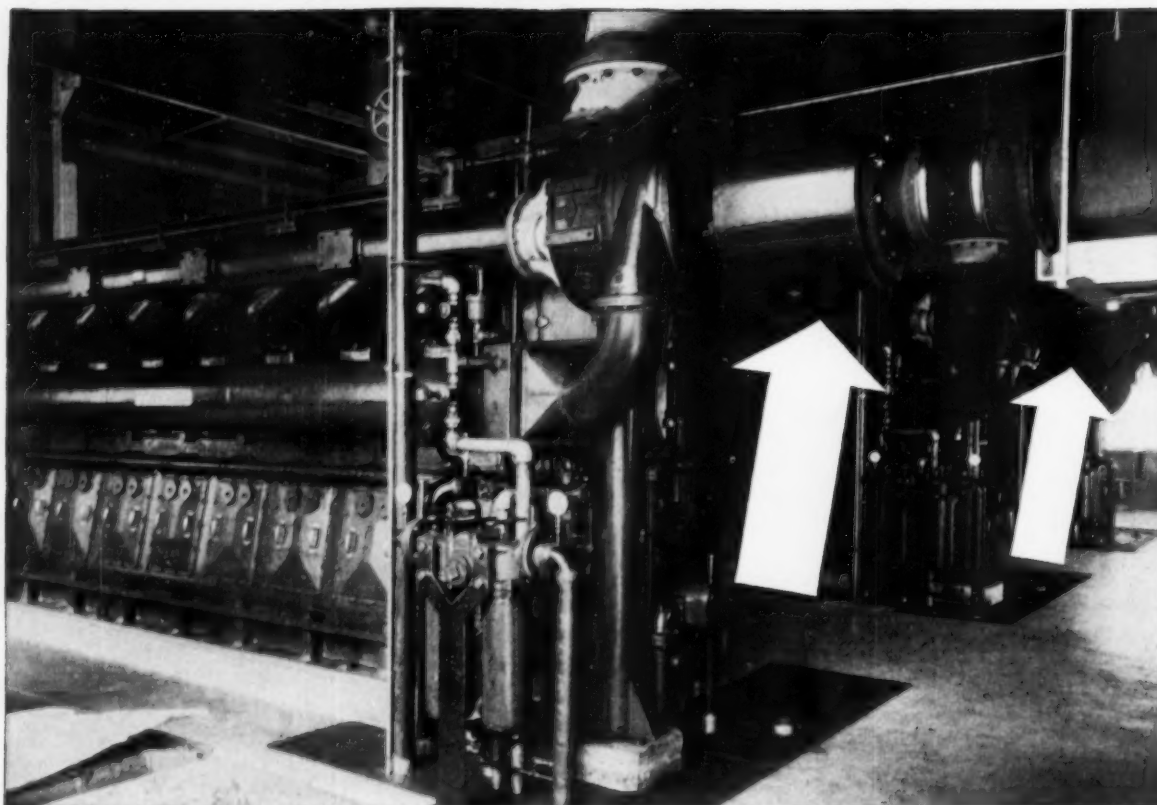
• Packard engines have a long history of contributions to the nation's defense. This is the latest. From the famed Liberty engines of World War I to the Navy's PT-Boat power plants of World War II, Packard has established a unique international reputation as the "Master Engine Builder."

PACKARD MOTOR CAR COMPANY, DETROIT, MICHIGAN



• The U.S.S. Endurance is the latest example of teamwork between the Navy and Packard for the greater effectiveness of America's defense.

Packard MASTER ENGINE BUILDERS



Air-Maze in-line silencers hush intake noise of Superior diesels in Ohio power plant

THE BELLEFONTAINE, OHIO, municipal power plant has had three turbocharged Superior diesels in operation since March 1952. Each 360 rpm engine drives a 1000-kw generator, has a turbocharged rating of 1440 BHP. These are dual-fuel engines, operating on gas during the summer when the city's gas plant produces a surplus and on normal diesel fuel at all other times. And they lick the noise problem with Air-Maze in-line silencers.

These in-line silencers muffle intake noise of air piped from a remote point. They reduce the noise level of the vibrating column of intake air to a point where it ceases to be objectionable. Air-Maze silencers help eliminate the high-frequency vibrations which usually cause the most

objectionable part of the noise.

Air-Maze also designs silencers to help eliminate low-frequency pulsating noise often found in naturally aspirated engines and compressors. Whatever *your* silencing or filtering problem, Air-Maze, the filter engineers, stand ready to help. In the last twenty-nine years, we have met and bested practically every diesel filtration and silencing problem.

Air-Maze serves the industry with a complete line of intake silencers, oil-bath filters, lube oil strainers, fuel filters, and other products. For help with your filter problem, contact your nearby Air-Maze representative or write The Air-Maze Corp., 25000 Miles Road, Cleveland 28, Ohio. In Canada, Masdom Corp., Montreal and Toronto; Fleck Bros., Vancouver.

The biggest names in diesels are protected by Air-Maze filters

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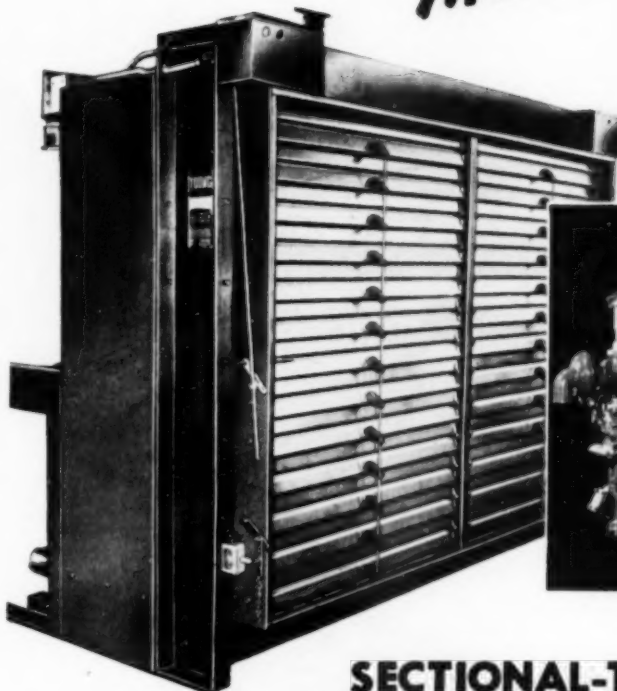
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These Young "Mono-Welds" provide efficient cooling under severe conditions, withstanding ambient temperatures, in this installation, varying from 0° F., to 125° F., under constant exposure to solar radiation . . .

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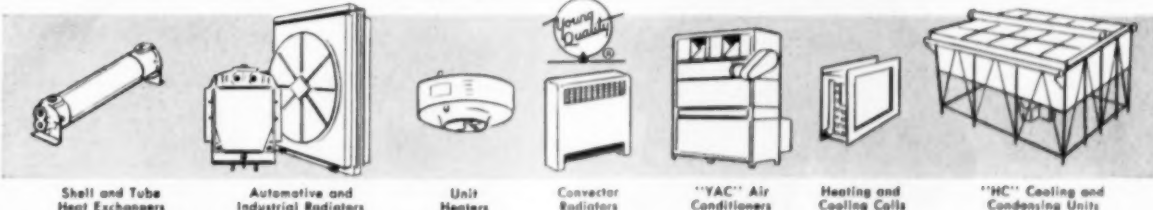
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That's why Hamilton 21½ x 27½ Diesel burns unblended heavy residuals

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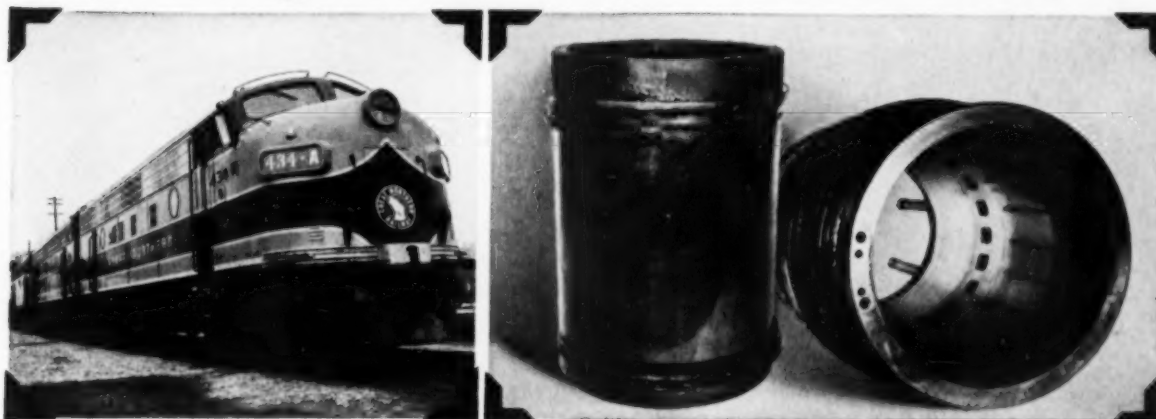
HAMILTON DIVISION HAMILTON, OHIO
BALDWIN-LIMA-HAMILTON



THE ENGINEER'S REPORT

DATA
LUBRICANT *RPM DeLo Oil R.R.*
UNIT *Diesel locomotive*
SERVICE *transcontinental freight=*
grades to 1.8%
PERIOD *3 years*
LOCATION *Minneapolis, Minn., to*
Wenatchee, Wash.
FIRM *Great Northern Railway*

504,851 freight miles in 3 years without overhaul!



ONLY 0.002 INCH WEAR was miked on liners of this locomotive's engines when they were inspected after 504,851 actual miles. Lubricated with RPM DELO Oil R.R., the engines operated without trouble of any kind during 3 years of tough service hauling freight over the Continental Divide. Representative piston and liner, above right, shown as they appeared when taken from one of the engines, demonstrate good condition of parts after this extended service. All rings were free when engine was torn down. Overhaul was performed only because of time and mileage on engine, which was estimated to have idled the equivalent of 100,000 miles in addition to actual mileage. Besides low wear of liners, other wear measurements (inches) were only: Wrist Pin—0.001; Wrist Pin Bushing—0.0015; Carrier Bushings—0.0015; Oil Ring—0.003.

REMARKS: Great Northern Railway's diesels haul heavy freight up grades as severe as 1.8%. Engines operate in dust and heat in summer, snow and extreme cold in winter.



FREE CATALOG: "How to Save Money on Equipment Operation," a booklet full of valuable information, will be sent you on request to Standard Oil Company of California, 225 Bush St., San Francisco, Calif.



TRADEMARK "RPM DELO" REG. U.S. PAT. OFF.

How RPM DELO Oil R.R. prevents wear, corrosion, oxidation



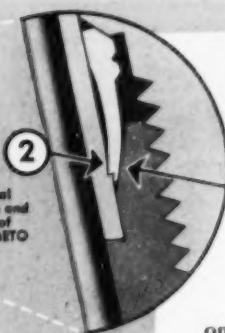
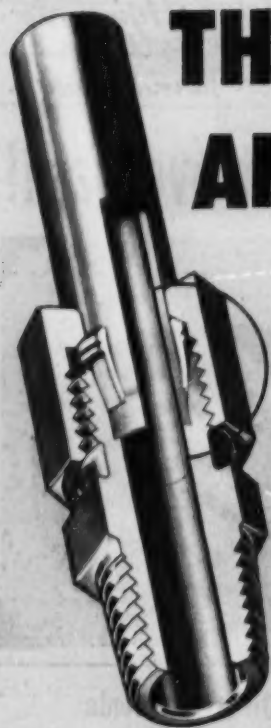
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LEAKPROOF CONNECTIONS THAT DEFY VIBRATION AND HIGH PRESSURE!

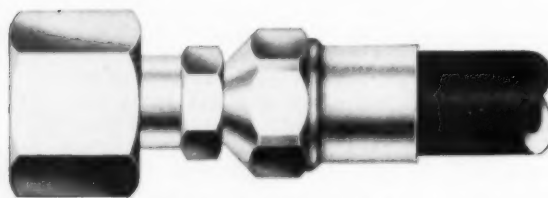


Faster Installation- Trouble-free Service

① With Weatherhead Ermeto you install high-pressure injection lines without upsetting tube ends . . . eliminate flaring, threading, welding or soldering on other connections. When the nut is tightened, the patent Ermeto sleeve shears a groove into the outside of the tube to form a positive seal that defies vibration and pressure. You can uncouple and reassemble the joint over and over. Weatherhead makes Ermeto in steel and stainless steel; hose assemblies with Ermeto ends are available on special order. Weatherhead also supplies tools to reseal any standard nozzle or pump for Ermeto connectors.

PACKARD "ERMETO" SPECIFIES

Famous Packard diesel engines for U. S. Navy mine sweepers use Weatherhead Ermeto connectors for positive, leakproof seals.









Ermeto Reusable Hose End



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Weatherhead industrial distributors
coast to coast

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This trademark  appears on every make of car, truck, bus, and tractor  on equipment for machine tools, diesel and hydraulic applications  on equipment for instrumentation, oil drilling, mining, road building  for aircraft, railway, and marine engines  for LP-Gas and anhydrous ammonia central equipment  this symbol represents more than 1500 products made by Weatherhead

PUROLATOR FILTERS

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FUEL
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AIR

**Preferred by more
ORIGINAL EQUIPMENT MANUFACTURERS
than any other make—**

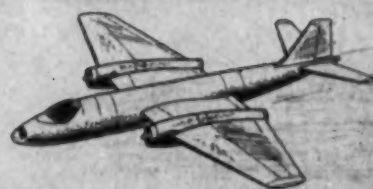
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Quickest way to get acquainted with the almost one thousand different types of Purolator filters is to send for the catalogs. Use the coupon!

*Reg. U. S. Pat. Off.

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MAGNETIC MINES?

Packard Diesels solve THIS
minesweeper problem with non-magnetic
Alcoa Aluminum—for crankcases,
pistons and bearing caps.

Why Aluminum?

Primarily because aluminum is nonmagnetic—a mine sweeper “must”. But there were other reasons, too. Aluminum dissipates heat fast; it resists corrosion and its light weight cuts over-all displacement... increases the efficiency and maneuverability of the vessels.

Why Alcoa?

Teamwork between Packard engineers and Alcoa's own specialists developed Packard's famous Ultramatic transmission—almost entirely Alcoa® Aluminum—and other aluminum improvements for their great line of automobiles.

This same teamwork led to sand-cast crankcases, as well as forged pistons for their 6-, 8-, 12- and 16-cylinder diesels... and forged bearing caps and other minor parts for *all* Packard Diesels.

Diesel engine manufacturers and users have relied on Alcoa's staff of development specialists for years—lightening a part here... increasing efficiency of a part somewhere else. Our sales engineers have a world of helpful information on aluminum advantages to the diesel industry. Just call your nearby Alcoa sales office, listed under “Aluminum” in the classified section of your telephone directory. Or write: ALUMINUM COMPANY OF AMERICA, 1987-G Alcoa Building, Pittsburgh 19, Pennsylvania.



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DETROIT PRESSURE and TEMPERATURE CONTROLS

protect Packard Non-Magnetic Diesel Engines

on new U.S. Navy Minesweepers!



Aboard the U.S. Navy's rugged new Minesweepers, you'll find the latest, most modern and reliable equipment available today in the marine field. And as you would expect, you'll find Detroit non-magnetic pressure and temperature controls providing ever-present protection for the Packard non-magnetic Diesel Engines which power these ships. That's because Detroit Controls, built and backed by

an organization with over 75 years of top-quality manufacturing experience, have been proven for reliability in over two decades of use by the U.S. Navy, Maritime Administration, Marine and Railroad industries. If you have a pressure or temperature control problem, let one of our engineering specialists help you solve it. Address your inquiry direct to the factory in Detroit.

DETROIT CONTROLS ON NEW PACKARD NON-MAGNETIC DIESEL ENGINES

PRESSURE CONTROLS—used on engine low lube oil pressure alarm systems.

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DETROIT "VERNATHERM" THERMOSTATIC ELEMENT—used in the engine-cooling water temperature regulating valves.

Catalog 100-D available on request.

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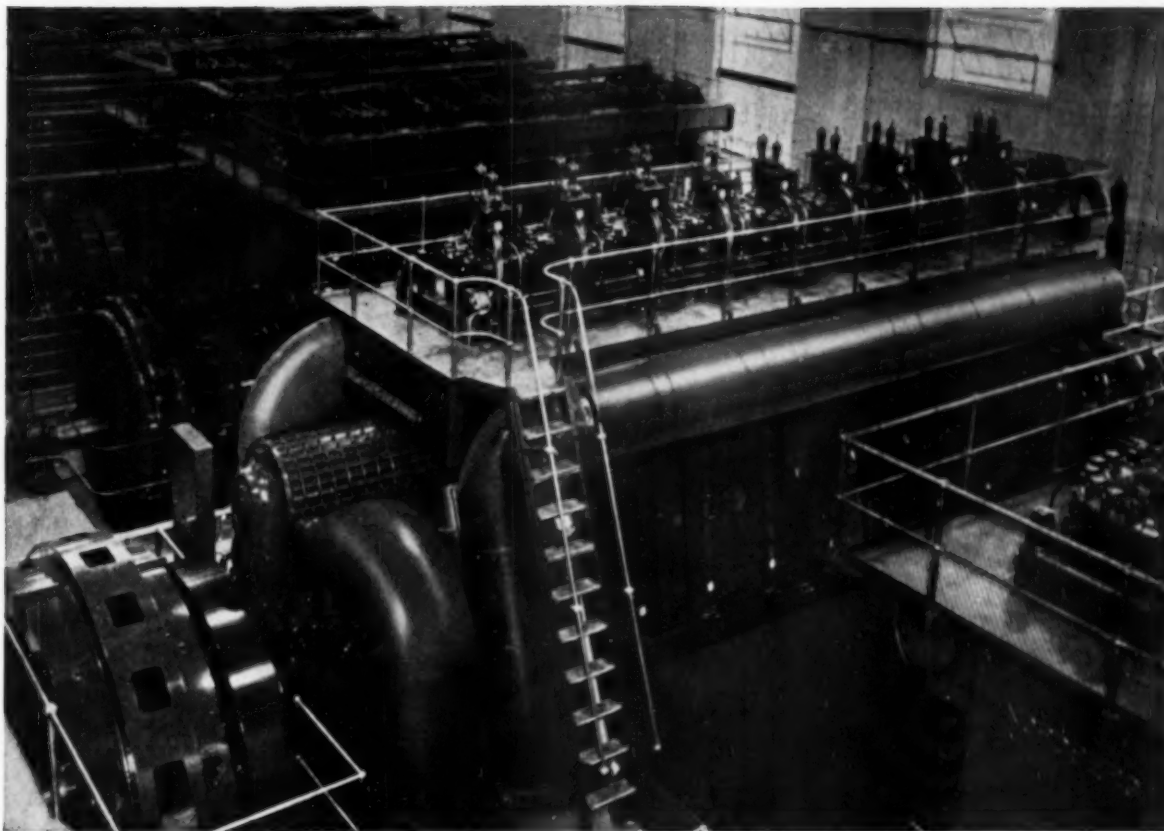
Representatives in Principal Cities • Canadian Representatives in Montreal, Toronto, Winnipeg—Railway and Engineering Specialties, Ltd.



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Largest Diesel Power Generating Station in the U.S.

**reduces cylinder and
piston ring wear with
SHELL ROTELLA OIL**

Electric power for the City of Grand Haven, Michigan, and the surrounding area, is generated by diesel engines in the largest municipal power station of its kind in the U. S. A. Shell Rotella Oil is the cylinder lubricant.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of

incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

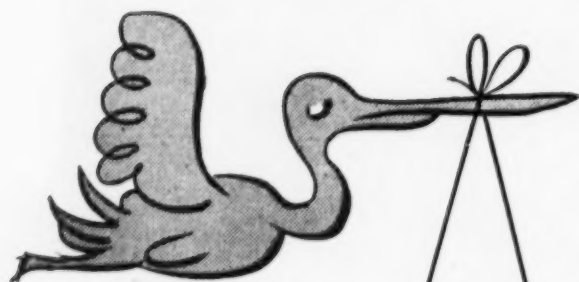
Write for technical information. See for yourself how Shell Rotella Oil can help reduce your engine maintenance costs.

SHELL OIL COMPANY

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A NEW ARRIVAL



To the 
air-cooled diesel
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Range NOW
 $1\frac{1}{2}$ - 40 H.P.

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New diesels get same "lube diet" that kept old units healthy...

For many years, the Las Animas Municipal Power and Light Company kept its original diesel equipment operating at remarkably low cost. Using Standard diesel oils, down time and maintenance were negligible in spite of greatly increased loads that forced the units far beyond their rated capacities.

In 1951, when two new 1750 hp. Nordbergs were installed in the Las Animas, Colorado, power plant, it was natural for plant officials to select STANDARD HD Diesel Oil on the basis of this outstanding past performance.

Used exclusively in the new units, STANDARD HD has set a new high for healthy performance. In over two years of continuous hard service, STANDARD HD has supplied clean, protective lubrication. After 6000 hours of operation wear was so slight that it could not be measured; engines are kept clean constantly in all working parts.



STANDARD HD
TRADE MARK
OIL

● Diesel plant operators throughout the Midwest have discovered they can count on low cost diesel operation when they use STANDARD HD Oil. STANDARD HD provides an economical solution for costly maintenance problems—ring sticking and breaking, carbon deposits, cylinder wear—because STANDARD HD Oil lubricates, cleans and protects.

A Standard Oil lubrication specialist stationed near your plant throughout the Midwest can help you secure successful results in the operation and maintenance of your diesels. For his services, call your local Standard Oil Company office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.



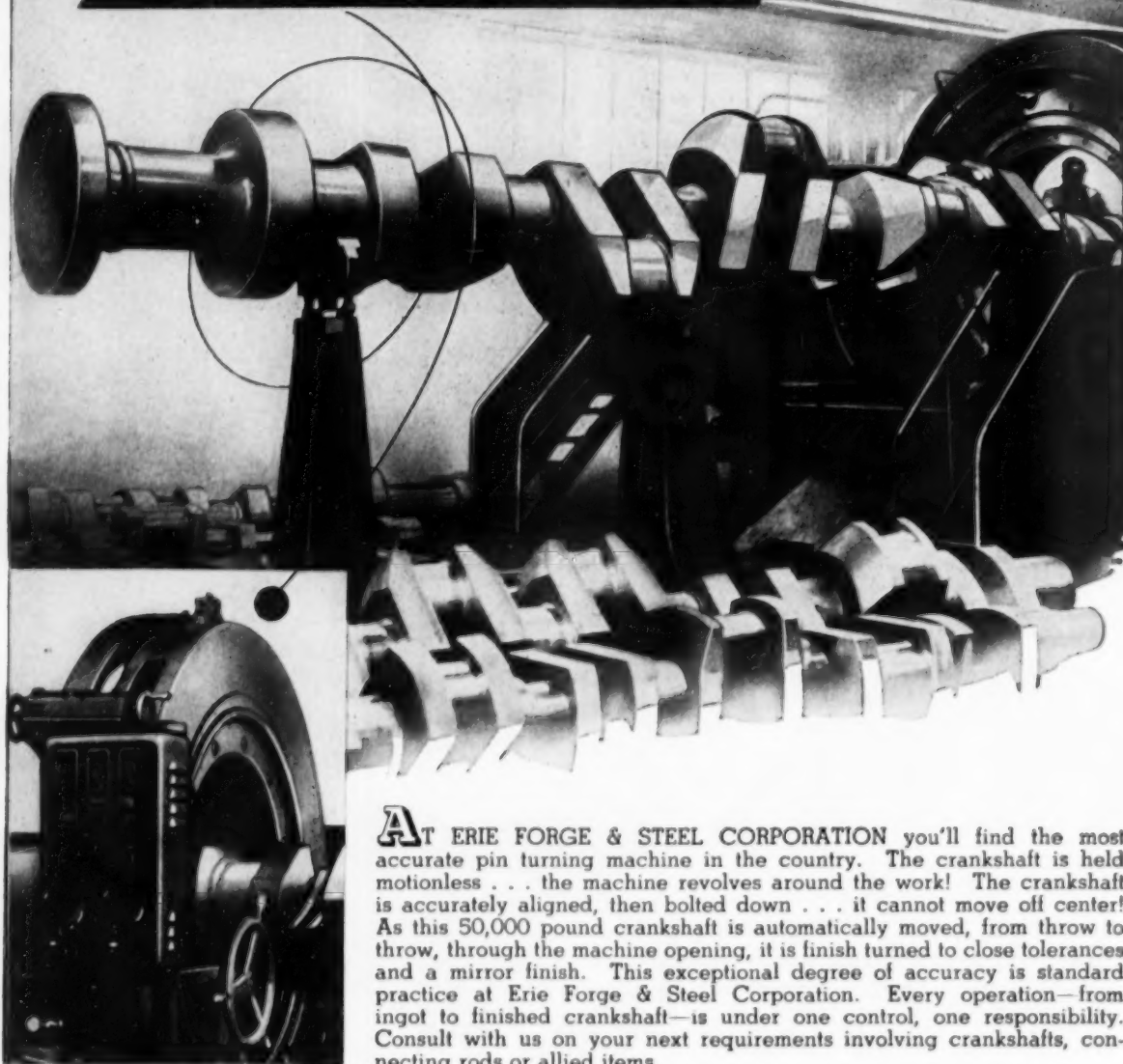
Ralph Barbee, plant superintendent of the Las Animas Municipal Power and Light Company, checks the operating log with E. C. Jeffries, Standard Oil lubrication specialist.

STANDARD OIL COMPANY
(Indiana)



A PIN TURNING MACHINE that revolves AROUND the WORK?

**This one does at ERIE FORGE —
to achieve MAXIMUM accuracy!**

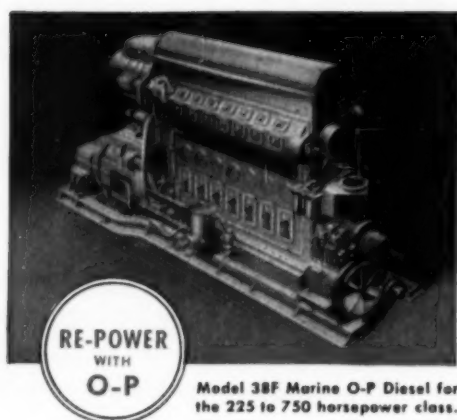


AT ERIE FORGE & STEEL CORPORATION you'll find the most accurate pin turning machine in the country. The crankshaft is held motionless . . . the machine revolves around the work! The crankshaft is accurately aligned, then bolted down . . . it cannot move off center! As this 50,000 pound crankshaft is automatically moved, from throw to throw, through the machine opening, it is finish turned to close tolerances and a mirror finish. This exceptional degree of accuracy is standard practice at Erie Forge & Steel Corporation. Every operation—from ingot to finished crankshaft—is under one control, one responsibility. Consult with us on your next requirements involving crankshafts, connecting rods or allied items.



ERIE FORGE & STEEL CORPORATION
ERIE, PENNSYLVANIA





Model 38F Marine O-P Diesel for the 225 to 750 horsepower class.

"He's spending more time at sea, that's why we see him less these days . . . and all because of something called Re-Powered with O-P."

Yes, there is a lot of talk on shore these days about those boats that have been re-powered with the newest in marine diesel power—the Fairbanks-Morse Opposed-Piston engine in the 225 to 750 horsepower class.

For this engine was specifically designed for putting more power, more speed and more performance in your engine space when you re-power. How? This engine is a *completely* packaged marine unit with all accessories . . . lube oil cooler, filters, pumps, heat exchanger and attendant piping engine mounted. Add to this the inherent compact design of the O-P engine that is 20% less in length and width . . . weighs about 20 pounds per horsepower . . . and you see why the new Model 38F offers you more power, more speed, more performance—in less space than with any other diesel engine.

There are more facts on the 38F that will be of great interest to you—low maintenance, reliability and economy. Call your nearby Fairbanks-Morse Marine Specialist—you'll be glad you did when you start spending more time at sea. Fairbanks, Morse & Co., Chicago 5, Illinois.



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a name worth remembering when you want the best

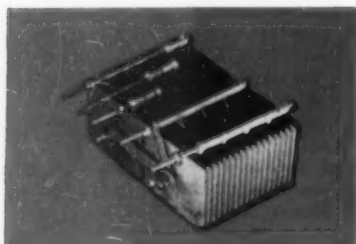
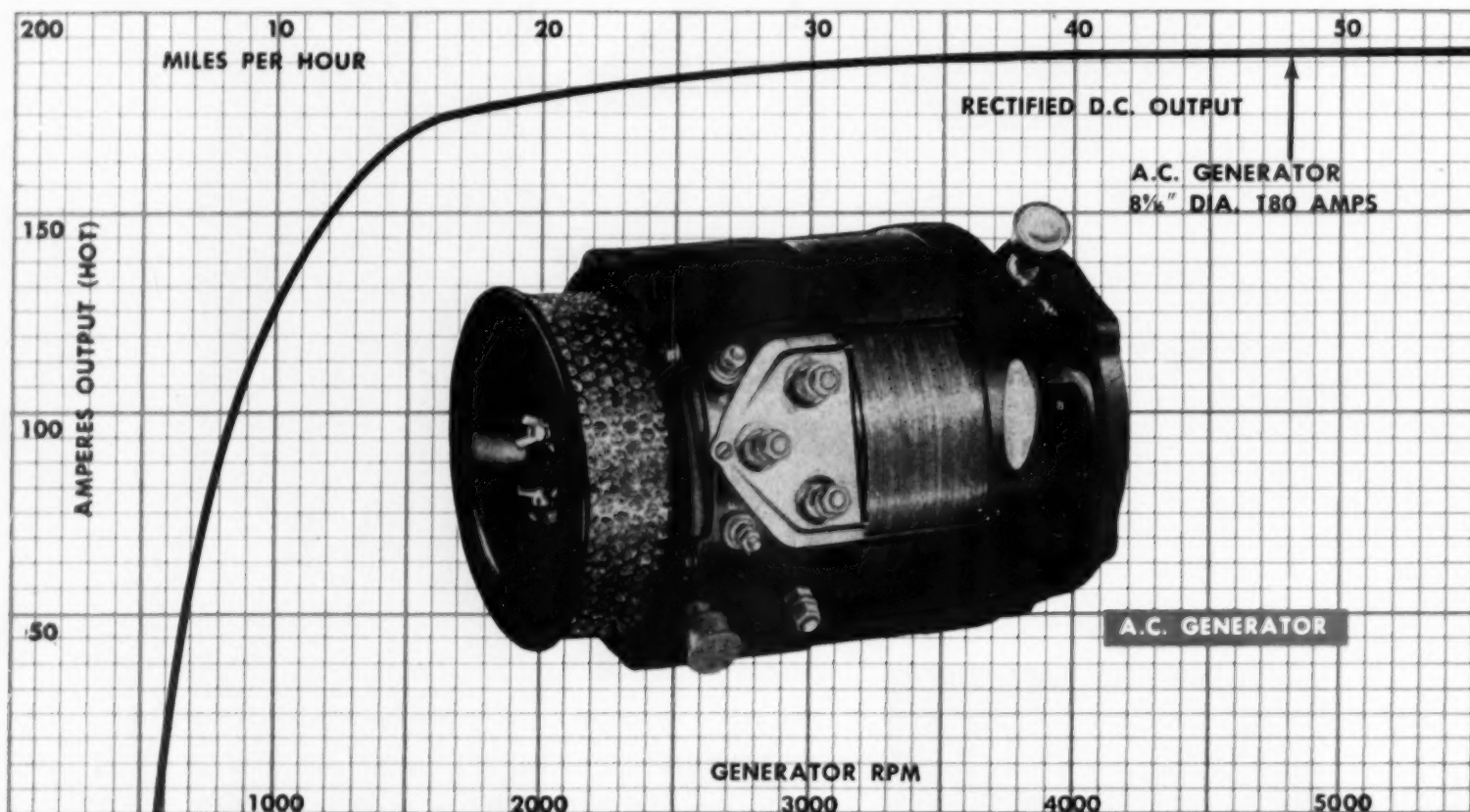
DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY
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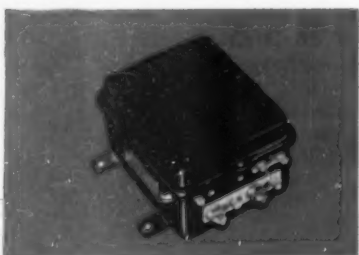


DELCO-REMY A. C. GENERATOR

Heavy-Duty 180-Ampere Output Capacity



Rectifier



Regulator

The Delco-Remy A.C. generator is the heart of a 12-volt A.C.-D.C. electrical system designed specifically for modern buses with fluorescent lighting and extra-heavy electrical loads.

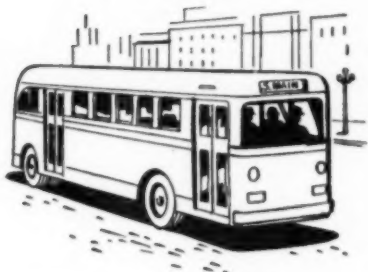
Desirable performance characteristics include cut-in at approximately 550 generator rpm . . . maximum output of 180 amperes at approximately 2000 rpm. The new generator supplies not

only alternating current for fluorescent lights but also ample direct current for the heaviest electrical loads coupled with lengthy engine-at-idle periods.

Impressive features of the new generator are its light weight, its very high output capacity, and its ability to operate over a wide speed range with greatest efficiency. Specify Delco-Remy electrical equipment on your new buses.

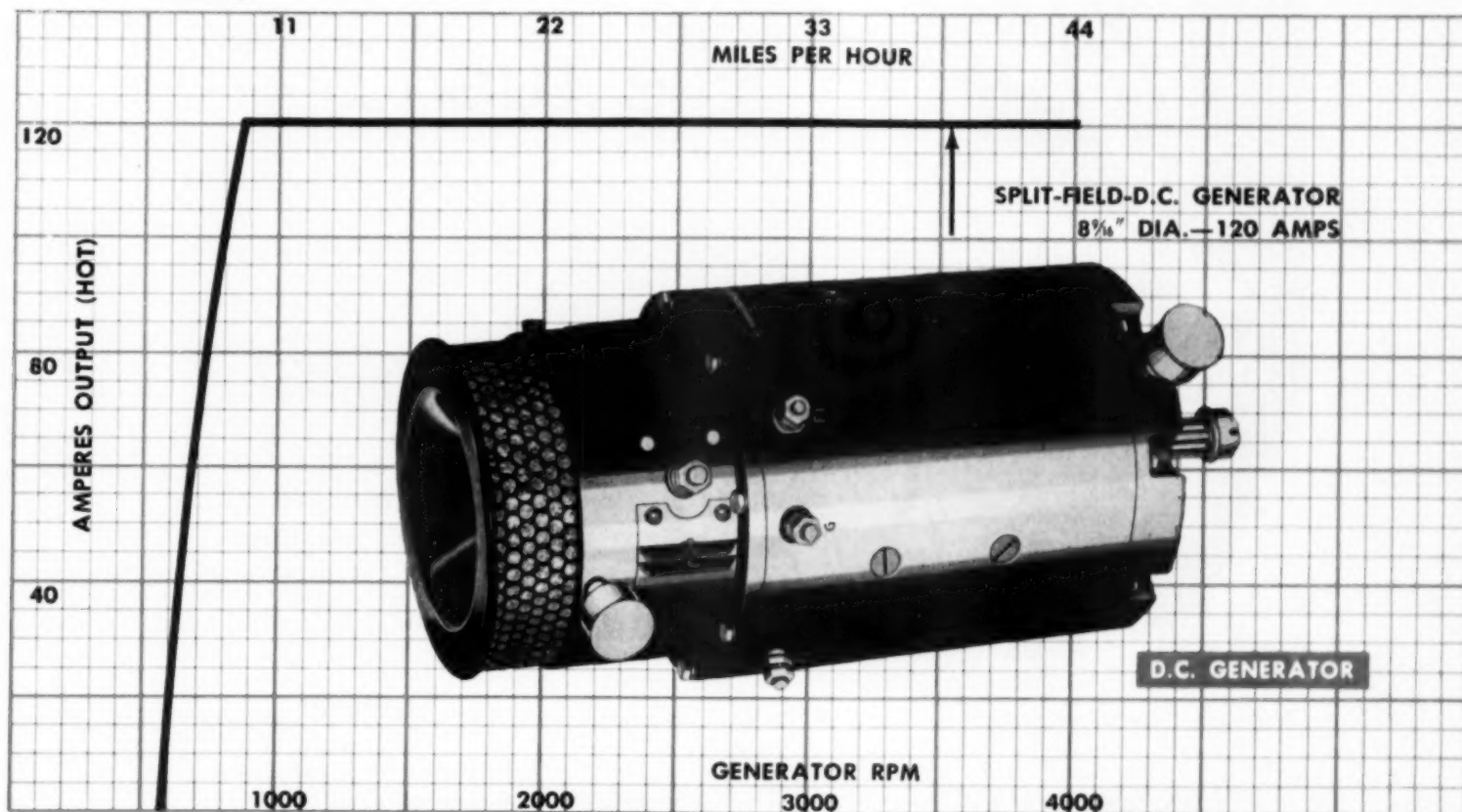
WHEREVER WHEELS TURN OR PROPELLERS SPIN

Right for the Job



DELCO-REMY D. C. SPLIT-FIELD GENERATOR

Heavy-Duty 120-Ampere Output Capacity

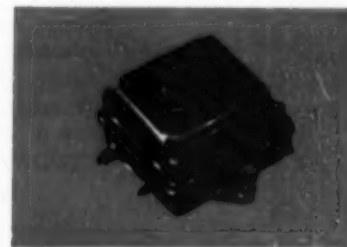


The Delco-Remy 12-volt split-field generator and its companion regulator are rugged and dependable—designed to meet the needs of transit buses having increased electrical loads coupled with a high percentage of engine idling time.

Desirable performance characteristics include low cut-in, high output at engine idle, and quick attainment of maximum output. Cut-in occurs at ap-

proximately 550 generator rpm; output reaches 70 amperes at approximately 700 rpm, maximum controlled output of 120 amperes above 850 rpm.

Operating benefits include reduced battery cycling, long battery life, and a simplified electrical system with sustained voltage—at no sacrifice in ruggedness or dependability. Specify Delco-Remy electrical equipment on all of your new buses.



Regulator

Delco-Remy

DIVISION, GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

WHEREVER WHEELS TURN OR PROPELLERS SPIN

FAMOUS LAST WORDS:



Let's face it—they won't send out advance warning notices of atom-bomb attacks. They just sneak over and let go when we're least expecting it—without even so much as a declaration of war. The emergency may be an atom bomb or it may be a fire, a flood, a hurricane. It's only good business to be ready for it—whatever it is. Take these precautions TODAY:

- ☐ Enlist the help of your local Civil Defense Director.
- ☐ Check contents and locations of first-aid kits.
- ☐ Send staff to Red Cross courses. They may save your life.
- ☐ Promote preparedness in your community. Your local CD Director can show you how.

Set the standard of preparedness in your plant city—check off these four simple points NOW.

SPACE FOR THIS

CIVIL DEFENSE

MESSAGE CONTRIBUTED BY



Rx Dr. J. J. Farnham



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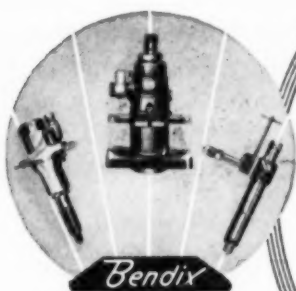
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BRITISH COLUMBIA
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AMERICAN BOSCH FUEL INJECTION

Serves on Packard Diesels, too...



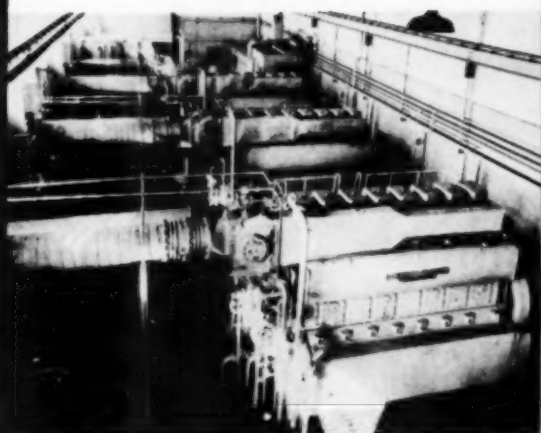
Like so many of the nation's Diesel engine manufacturers, the Packard Motor Car Company relies on American Bosch precision fuel injection equipment for premium performance and dependable service.

American Bosch congratulates Packard for its contribution to the development of the U. S. Navy's new Diesel-powered mine sweepers... and is proud to have a part in this valuable addition to our nation's arm of defense. American Bosch Corporation, Springfield 7, Massachusetts.



AMERICAN BOSCH

the **POWER** behind Alberta Crude...

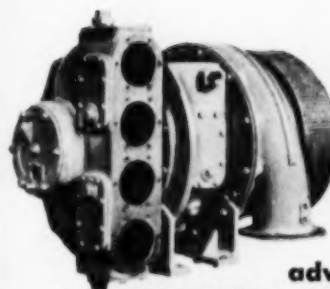


The Edmonton pumping station, the starting point of the lines, uses these 3 Nordberg Supairthermal Dualfuel engines equipped with Brown Boveri Turbo-Chargers rated at 1780 hp. at 500 rpm. The engines operate on a dualfuel system. Natural gas, available in the Edmonton area, is more efficient to use than crude taken from the line.

NORDBERG SUPAIRTHERMAL **Diesel Engines**

equipped with

BROWN BOVERI exhaust gas **Turbo- Chargers**



A typical Brown Boveri exhaust gas Turbo-Charger. These are available in various sizes for charged outputs from about 100 BHP to 6,000 BHP, 4- or 2-cycle operation.

advantages of **BROWN BOVERI** exhaust gas **TURBO-CHARGERS**

- Continuous power increases of 100% or more.
- No increase in operating costs since chargers run on exhaust gases from turbines.
- 40% and more reduction in space and weight per HP of supercharged engine.
- Self-contained lubricating system eliminates special oil piping outside the engine.
- Air pressure equalization prevents pollution of blower wheel and bearings.
- Ideal for use at high altitudes, too, since pressures can be increased to that of sea level operation.
- Only Brown Boveri offers engineering design and application assistance of internationally recognized specialists in turbo-chargers.

ALBERTA Crude now makes its way from Edmonton, Canada, to Pacific Coast markets through the 718-mile Trans Mountain Pipeline recently placed in operation. This pipeline, crossing extremely mountainous country with few roads, depends on the power supplied by 12 Nordberg Supairthermal diesel and Dualfuel engines equipped with Brown Boveri Turbo-Chargers for pumping 150,000 barrels daily.

The super-charged Nordberg diesels in the four pumping stations of the system supply 20,010 hp. And, the high operating efficiency of these engines is increased with the addition of Brown Boveri Turbo-Chargers.

All Brown Boveri turbo-charger-equipped diesel engines represent the combined engineering efforts of the engine manufacturer's staff and Brown Boveri diesel specialists — another reason for the high operating efficiency and economy of these engines.

Learn how Brown Boveri Turbo-Chargers improve the over-all performance of a diesel engine. Write for descriptive data today.

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"6,000 employees . . ."

A. W. STEUDEL

President
Sherwin-Williams Company

"Naturally, we of Sherwin-Williams give complete endorsement to the Payroll Savings Plan. But we feel that mere approval of a national thrift movement that contributes so much to the personal security of our employees and the economic stability of our country is not enough. In our continuing effort to build employee participation in our Plan, we utilize the personal contacts and enthusiasm of our enrolled Payroll Savers. A recent person-to-person canvass by our employees put a Payroll Savings application blank in the hands of every man and woman in our plants and offices. The result, nearly 6,000 serious savers were added to our Payroll Savings Plan."

The personal interest of executives like Mr. Steudel, and the systematic bond purchases of more than 8,000,000 enrolled Payroll Savers are reflected in the following figures:

- In March, 1954, purchases of U.S. Savings Bonds, Series E and H, by *individuals* reached \$474 million, highest March figure in 9 years—a gain of 20% over March, 1953.
- Purchases of E and H Bonds, by *individuals* during the first quarter of 1954, totaled \$1,380 million—the highest for any quarter since 1945.
- The *cash value* of Series E and H Bonds held by *individuals* at the end of March, 1954, was \$37 billion, 175 million—the highest in the thirteen year history of the Savings Bond program.
- Payroll Savers are serious savers: over 75% of the

amount of Series E Bonds that matured since May, 1951—almost \$9 billion—is still being held by individuals under the Treasury's 10 year optional automatic extension plan.

- For the third straight month of 1954, sales of E and H Bonds exceeded maturities and redemptions. The sales excess amounted to \$242 million on March 31—the highest first quarter net since 1950.

If employee participation in your Payroll Savings Plan is less than 50%—or if your company does not have a Payroll Savings Plan, get in touch with Savings Bonds Division, U.S. Treasury Department, Washington, D.C. Your State Director, U.S. Treasury Department, will be glad to help you install a Plan and build employee participation.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

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Great new line of
GENERAL MOTORS LOCOMOTIVES



New 2400-Horsepower Passenger Locomotives Delivered to Illinois Central

With increased horsepower from two 12-cylinder Diesel engines, availability of two steam generators per locomotive

for train heating, plus a host of improvements, the great new E9 ideally meets the demands of high-speed passenger service.

More than 200 of America's crack passenger trains follow General Motors locomotives today because for more than twenty years these powerful Diesel units have demonstrated their ability to maintain high-speed schedules at low cost.

THE BEST LOCOMOTIVES ARE EVEN BETTER TODAY!

ELECTRO-MOTIVE DIVISION · GENERAL MOTORS



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PANISH "POSITROL"™
100% MECHANICAL
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The discriminating Naval Architect, Yachtsman or operator of Commercial Craft makes this specification, for he knows that only PANISH CONTROLS give him absolutely dependable, Split-Second maneuverability with built-in safety features, protecting his engines and vessel under any and all conditions of service.

One Branch of our Armed Forces wrote in 1948, viz: "The Panish Controls installed in 1940 on our Twin Engined Vessels (over 300) are still operating 100% and as far as maintenance

and upkeep is concerned, we are never bothered with it."

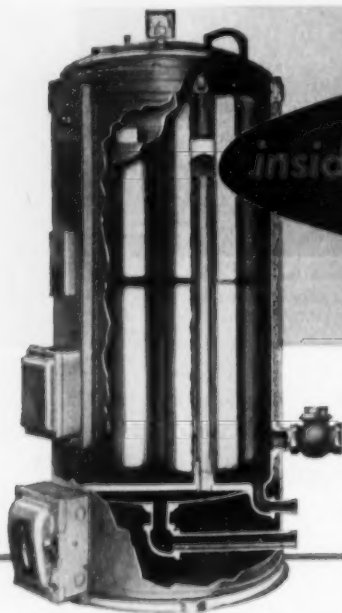
Panish Controls is the foremost designer and manufacturer of a complete line of Remote Engine Control Equipment covering every type of Marine engines—Gas and Diesel. Our experience and facilities, combined with the most advanced engineering and manufacturing practices, are your insurance of trouble-free operation and maneuverability exceeding your fondest expectations.

For complete information write to: PANISH CONTROLS, 191-203 Bennett Street, Bridgeport 5, Conn.

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- NAVAL CRAFT—Rescue Vessels—Submarine Chasers—PT Boats—Special Purpose Vessels—Destroyers—Minesweepers

Congratulations to Packard on a Brilliant Development and a Job Well Done



only **HONAN-CRANE**
inside tip... **DIESEL OIL PURIFIERS** give you so many vital
ENGINEERING FEATURES

The Honan-Crane "Multi-Cartridge" Purifier is engineered, inside and out, to provide the high-flow, thorough oil purification essential for diesels. Removes all types of harmful contamination . . . substantially reduces engine wear and maintenance costs . . . quickly pays for itself in oil savings alone!

Here are a few of the time-tested features that make Honan-Crane preferred for safety and savings wherever diesels are used » »

INTERCHANGEABLE CARTRIDGES FOR HONAN-CRANE PURIFIER



TYPE "MC"—Cotton bag packed with Cranite (fuller's earth). Removes solids and products of oxidation, acids, gums, etc. Provides refinery-type purification.



TYPE "MF"—Perforated metal basket packed with Palconia (cellulose fiber). Recommended for additive oils for complete removal of dirt, scale and other solids.



TYPE "S"—Contains Palconia (cellulose fiber). Performs same as Type "MF." Fiber center-tube permits complete disposal of spent cartridge by burning.



TYPE "E"—Similar to Type "S" except that filtering material is cotton waste and excelsior. Type "E" is recommended when water is encountered in the oil.

WRITE US ABOUT YOUR OIL PURIFICATION PROBLEM

Honan-Crane Fuel and Lube Oil Purifiers are available for any size or make of Diesel Engine. For detailed information, write Honan-Crane giving make, model and H.P. of your diesel. Describe any unusual aspects of your oil purification problem.

- 1 Cartridges are readily interchangeable to provide type and degree of purification required.
- 2 Clean oil is drawn from top of purifier. Maximum efficiency of each cartridge is utilized.
- 3 Cartridge design prevents channeling or by-passing. Multiple units provide high flow rate.
- 4 Electric heater bands maintain correct oil temperature. Steam, hot water heating available.
- 5 Oil-and-gas-tight seals and gaskets prevent seepage. Dirty oil cannot contaminate clean oil.
- 6 Double-decked cartridges save floor space, permit clean design, greater operating efficiency.
- 7 Positive locks and pressure springs keep cartridges securely in place, prevent by-passing.
- 8 Purifier is fully equipped with automatic controls and safety features. Requires no attention.



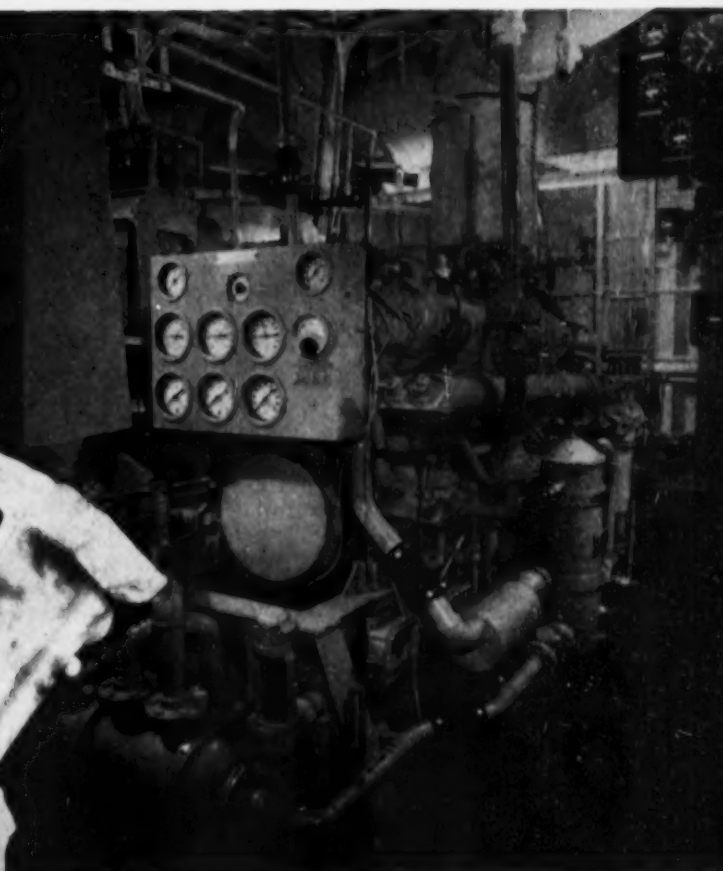
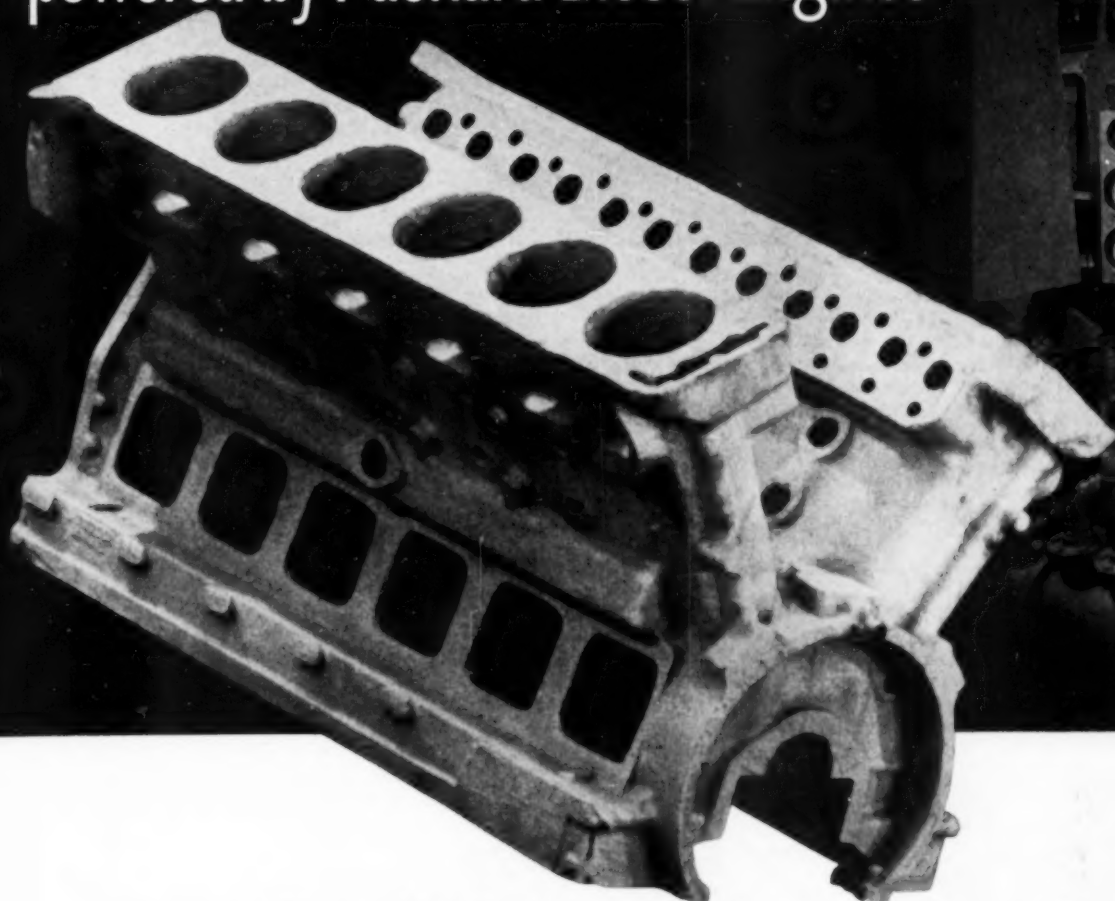
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The U.S. Navy Minesweeper am435

powered by Packard Diesel Engines



... with BOHN Aluminum Crankcase Castings!

Each AM 435 crankcase casting weighs over 700 lbs. It is cast in a mold which requires the precise fitting and venting of 64 cores. Close tolerances, rigid quality specifications are held through every step. And since the engine is liquid-cooled, the finished casting must have a uniformly high density. At Bohn, the solution of intricate aluminum casting problems is a tradition of nearly half a century.

BOHN ALUMINUM
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1400 LAFAYETTE BUILDING
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"Torqmatic Drives Cut Costs"



Heading down a rock-strewn grade with a 40-ton payload at Gavins Point Dam, this bottom-dump "Euclid" easily takes the rough going with Allison's TORQMATIC DRIVE transmitting engine power.

Western Contracting Corporation started saving money when the firm put a fleet of TORQMATIC-equipped 27-yard Euclid bottom-dumps to work at Gavins Point Dam. Company officials report:

"Clutch repairs are eliminated in the TORQMATIC-equipped units because there's no clutch pedal for drivers to push. Clutch life averages 90 days in a fleet of direct-drive trucks also working for Western on this job.

"Used to lose as many as 4 drive lines a week with drivers *manually* coordinating engine and drive line on the direct-drive units... *never lost a drive line* with TORQMATIC DRIVES."

On TORQMATIC-equipped trucks, drivers quick-shift at full throttle—

have only 3 forward speeds (instead of the usual 7 or 10) to handle all loads and grades. The converter-transmission team eliminates gearshift guess and gearbox clash. TORQMATIC DRIVES have such an excellent operating record on this job that the operator intends to specify them in future equipment orders.

If you're one of the men who's changing the face of the earth, do it better and at less cost with Allison TORQMATIC DRIVES in your units. For more information, ask your equipment dealer, manufacturer or write:

Allison Division of General Motors
Box 894D, Indianapolis 6, Indiana

ALLISON TORQMATIC DRIVES

Unbeatable Team for Maximum Operating Economy

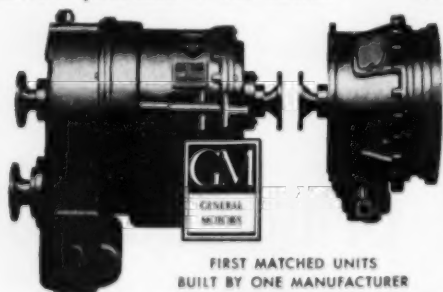
Reduces maintenance costs by absorbing shock—eliminates engine lugging—prolongs equipment life.

Holds power to load at all times—no clutch pedal to push—no gearshift guess.

Quick-Shifts at full throttle with finger-tip hydraulic control.

Only torque converter-transmission team designed to work as a unit and built by one manufacturer.

Cuts driver training costs.



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BUILT BY ONE MANUFACTURER
COMPACT, EFFICIENT HYDRAULIC DRIVES FOR CRANES • TRUCKS • TRACTORS • SCRAPERS • SHOVELS • DRILLING RIGS

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TORQMATIC DRIVES

PACKARD MOTOR CAR COMPANY

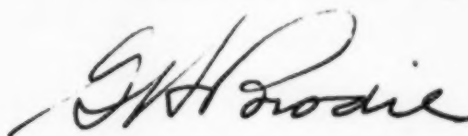
DETROIT 32, MICHIGAN

When the editor of DIESEL PROGRESS magazine came to PACKARD to gather information for this special issue, it occurred to us that an industry seldom has an opportunity to show the teamwork of the many component firms in meeting national defense needs.

In telling this story of the new aluminum diesel engines for the U. S. Navy's minesweeper program being conducted by 34,000 men in 49 shipyards, this authoritative publication has done an outstanding editorial job. We believe it will prove of wide interest through industry and government circles.

PACKARD, with its 26-year history in diesel engine making, is proud to be represented in this section which includes so many firms prominent in the development of diesel power for marine engines.

Packard Motor Car Company



George H. Brodie
Vice President
Defense & Industrial Operations

Editor's Note

The launching of the U.S.S. *Endurance*, AM 435, with its new diesel power plant, brings back into focus the marine program of Packard Motor Car Company which has been one of the pioneers in diesel engine development, although best known for the manufacturing of its high quality automobiles.

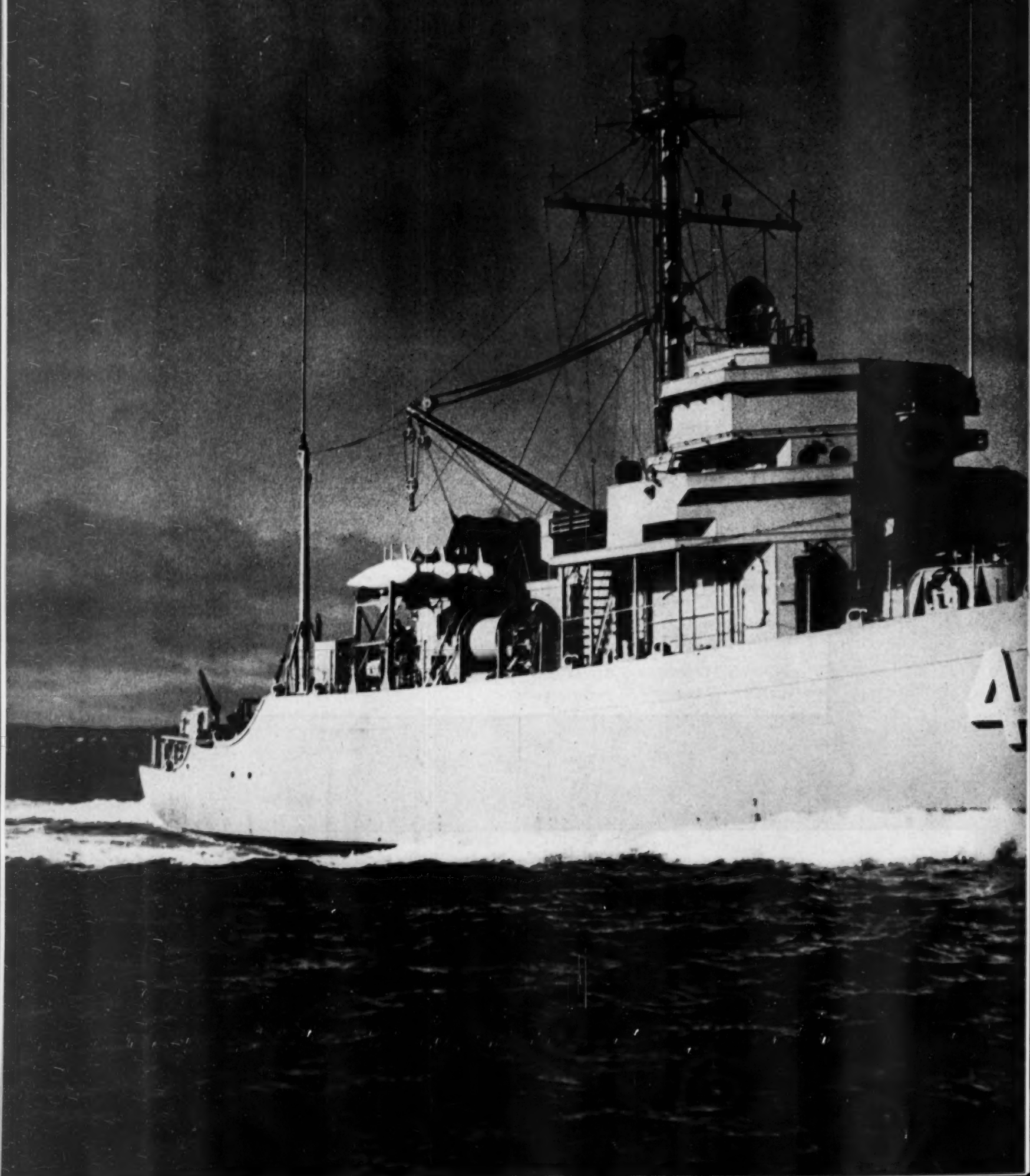
The company's history in diesel engines goes back to 1928 when it designed and built the first diesel airplane engine to take a plane off the ground, followed by experimental work on diesel truck engines during the nineteen-thirties.

The new diesel engines for Navy minesweepers are based on research which draws upon the company's wartime experience in building all the marine engines for the nation's torpedo boats. Total production of the

diesel engines described on the following pages now goes to the Navy.

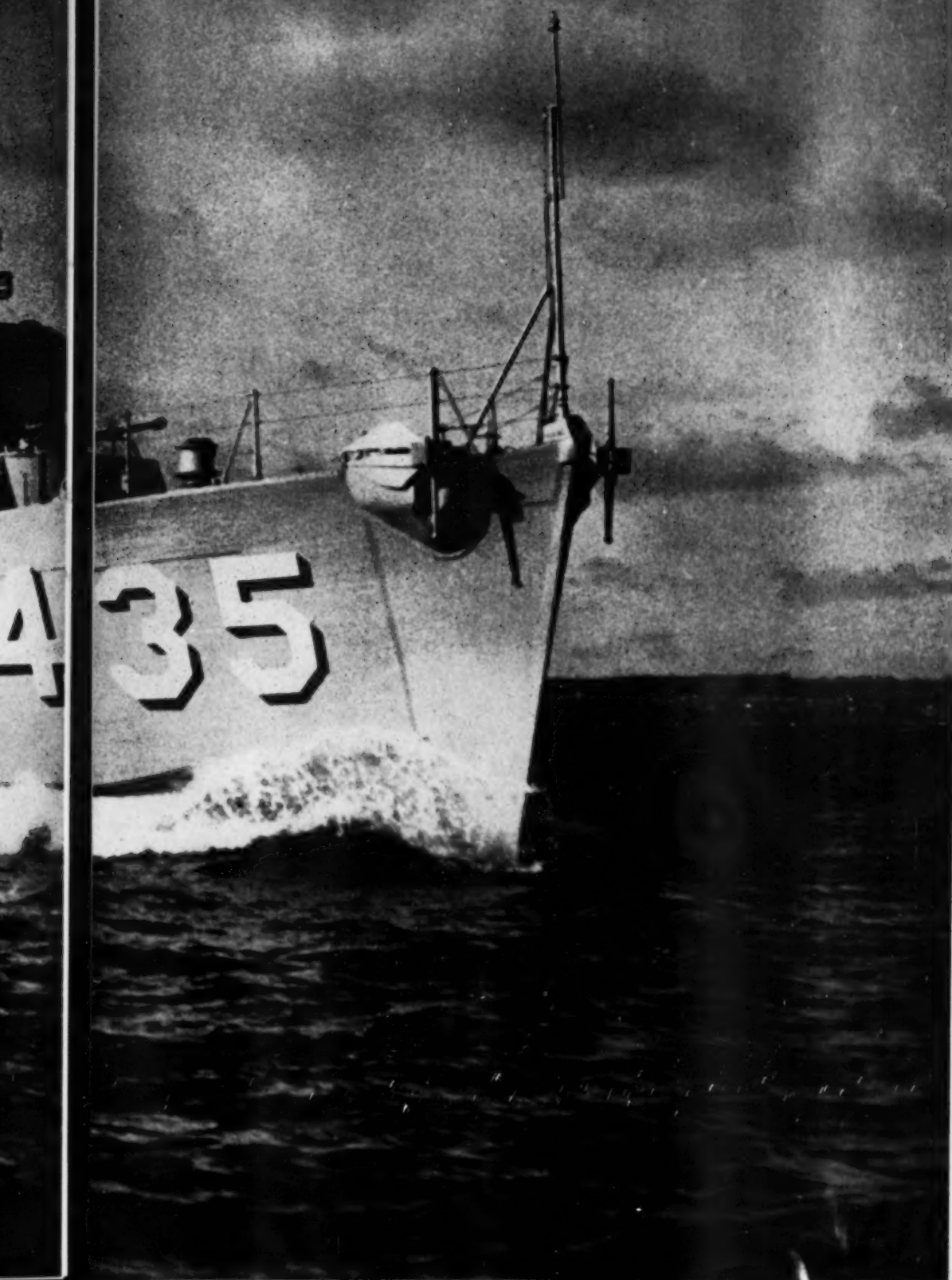
These new engines for the Navy's minesweeper program were brought to full production with the announcement of the Packard revitalization program extending to every area of the 55 year old fine car maker's business.

This program under the leadership of new Packard President James J. Nance has been marked by: 1. Accelerated engineering research and design in marine and aircraft engines. 2. The return of the company to the luxury field with its Packard cars. 3. Placement of a new management group which brought the average age of the 26 top executives down from 59 to 46. 4. A multi-million dollar manufacturing facility modernization and improvement program. 5. Development work on diesel engines for Army tanks and on other military requirements.



MINESWEEPER AM-435 POWERED WITH NEW PACKARD DIESEL

By Charles F. A. Mann



ON almost the first rainless Saturday in six months, not 3000 feet from where, 11 years before, the famous diesel merchant ship *Cape Alava* slid into the deep waters of Commencement Bay at Tacoma, another chapter in diesel-marine history was written March 19th. The first Navy ship to be commissioned at Tacoma Naval Station since it was established on the site of the former Todd Seattle-Tacoma Shipbuilding Corp.; the first of a whopping order of nine of the biggest class Navy minesweepers, some \$60 million worth, delivered by the noted J. M. Martinac Shipbuilding Corporation and the first large minesweeper completed on the Pacific Coast featuring the new lightweight Packard 142 series diesel engines, the U.S.S. *Endurance* got off to a lucky and auspicious start.

She was proudly commissioned by Capt. H. F. Agnew, head of the new Naval Station, in the same terse manner as if it were an aircraft carrier or a giant cruiser, and turned over to her commander, Lt. L. E. Martin, and a hand-picked crew from San Diego of over 70 men. First of a large number of minesweepers to be outfitted under the new program at Tacoma Naval Station, she left immediately for her shakedown cruise at sea. Her keel was laid January 15, 1952; she was launched August 8, 1952. Her sponsor, fittingly, was Miss Geraldine Ann Borovich, daughter of the General Supt. of Martinac Shipyard, Mr. Fred Borovich, who gathered laurels for his execution of this contract at almost every stage of the way, a fact attested to by both the Navy and Packard engine people, whose job was to pioneer a different type of construction and a vastly more complex ship than the long line of commercial craft the yard is noted for.

Unlike commercial work, the construction of a minesweeper that is almost totally non-magnetic, besides being heavy on the total horsepower installed in proportion to its length and draft, is a challenge to the skills of the wood and diesel shipbuilding industry anywhere. To assure great strength, yet moderate weight, the basis of the hull which is 100% wood including the deckhouse, new techniques in fabricating both native Douglas fir and eastern oaks had to be renovated and tried for the first time in this area. The specifications for the whole series of non-magnetic fastenings of aluminum alloy, bronze, brass, monel, stainless steel and copper called for widespread manufacturing ingenuity throughout a list of over 200 U.S. suppliers of fasteners, accessories, deck, auxiliary and main machinery. Sections of equipment seem thick in the photographs, but generally speaking the thicker sheets and castings of non-ferrous metals are actually lighter weight and stronger than the conventional items they replaced. The sheer ingenuity of suppliers of everything from cast bronze alloy fuel, water and lube tanks, to big bull gear wheels on the winches and thick shafting below decks has awakened new interest in the whole field of U. S. industrial production, geared to make the most of everything in the U.S.A. except iron and steel.

A grizzled Navy officer opined sagely that the impetus given equipment makers in this minesweeper program alone is worth the total cost to the U.S. Treasury, from the single standpoint of practical research. A future war might cut off

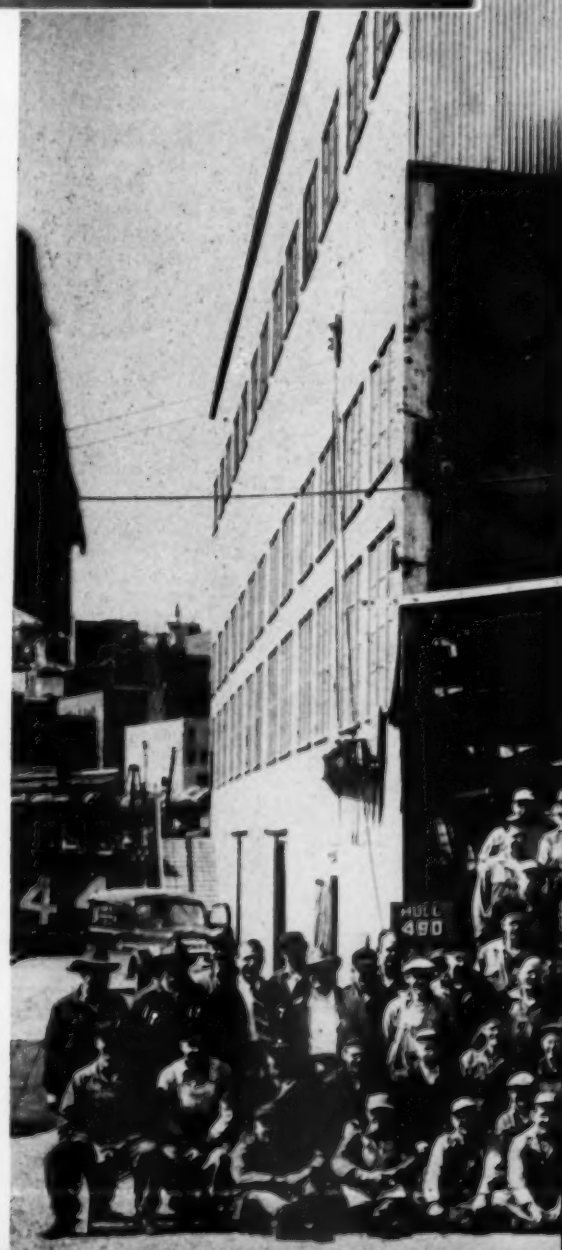
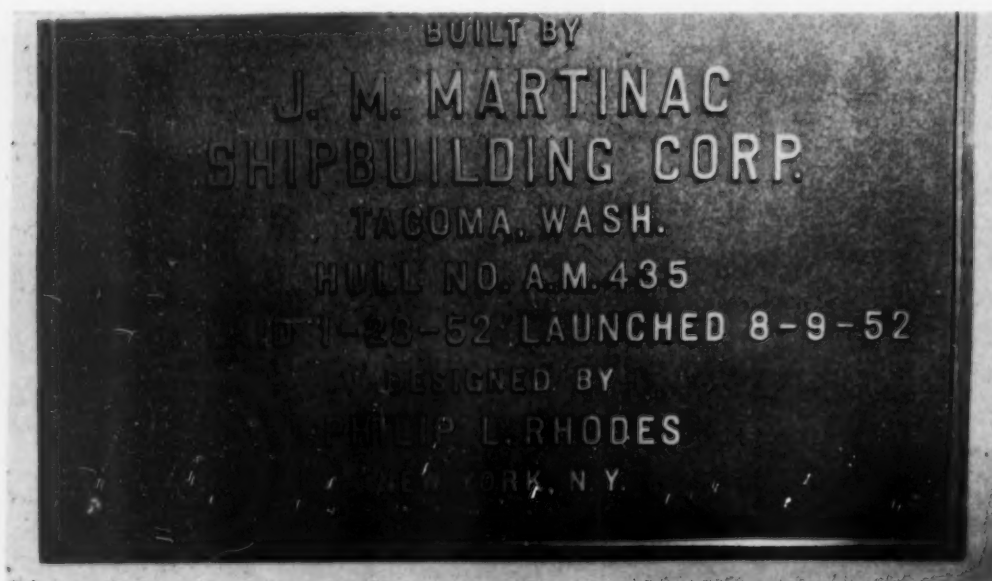


As the U.S.S. Endurance was commissioned on March 19, Rear Admiral A. M. Bledsoe (at extreme right), commandant Thirteenth Naval District, is just about to turn the ship over to its new skipper, Lieutenant L. E. Martin (center).

America's iron ore supply, but it is possible to keep our vast, complex economy running on a mere fraction of our current annual consumption of iron, if U.S. industry as a whole will examine the Navy minesweeper program and translate its practical results into the rest of our industrial planning and production. And even now, at Tacoma Boeing Airplane Company's gas turbine is teamed with diesel in a portion of this minesweeper program building in nearby shipyards. By virtue of weight saving alone, the aircraft industry is almost independent of steel and iron. And now the Navy shows what it can do in the same field, paving the way for the new industrial revolution that is

sweeping America as production of alloys, aluminum, copper, and other metals gets underway.

When Admiral A. M. Bledsoe, Commandant of the 13th Naval District at Seattle, got through tracing shipbuilding history, both around the world and in Tacoma since 1885, and explained how the Navy counted almost as heavily on minesweepers as it did its submarine program for the future, both the audience and crew practically exploded with pride and suddenly realized that this was the first ship of its class the Navy had decided to cite to the world as an example of what can be done to solve today's problems of defense. The successor to



Cape Alava, which was the very first diesel merchant vessel commissioned in the United States in World War II, stood it well and showed off her non-magnetic alloy and aluminum interior.

As this type of minesweeper is the largest and the most elaborately constructed and equipped of the three sizes currently being built in the Northwest, problems of fabricating the hull and superstructure were unusual and called for unusual working specifications. Principal dimensions of the AM class vessels are as follows:

Length	171 ft. 6 in.
Beam (extreme)	35 ft. 1/2 in.
Molded Depth	22 ft. 6 1/4 in.
Displacement	750 tons
Fuel	44 tons
Water	14 tons
Lube oil	2 tons

Directly in charge of construction, under Messrs. J. M. Martinac, chairman and J. S. Martinac president of the shipyard, was Mr. Fred Borovich, general superintendent; Ted Ultsch, machinery superintendent; Paul Erickson, engineering superintendent and Norman Nordlund, hull superin-

tendent. This first vessel and the others in the original contract all have solid Douglas fir keel timbers specially cut from long clear logs of a type rapidly becoming scarce. The keels and keelson pieces in the latter portion of the Martinac contract however, will be laminated fir.

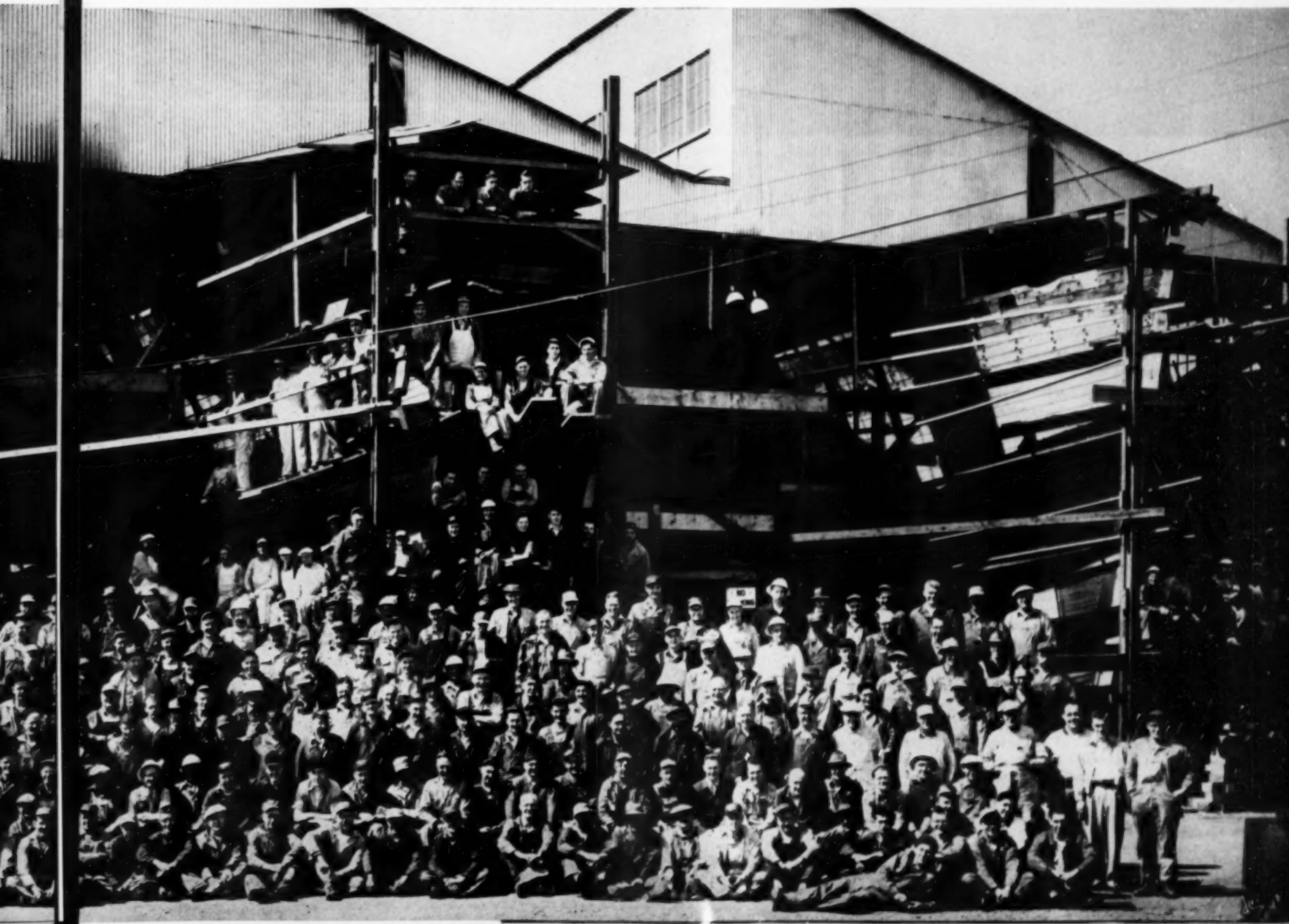
It is in the handling of the laminated structural members that the shipyard turned up unusual techniques. The whole ship, beyond the solid fir keel and keelson is fabricated from laminated select pieces that are brought into the yard rough, then surfaced, end scarfed, and after gluing are clamped in a special press and quickly heated by a novel new patented electronic heater, built in Tacoma by a nationally known firm that has made tremendous strides in fabricating small wood strips and sheets into large pieces, right on up to roof trusses and bridge girders. Horn timbers, stem, beams, forward shelves are all laminated Douglas fir, while the main ship frames are laminated white oak from Texas. All laminating is done in the same general manner, the final heating requiring a matter of seconds, where older methods required hours. The techniques were developed by the yard, largely a pioneering effort in this construction.

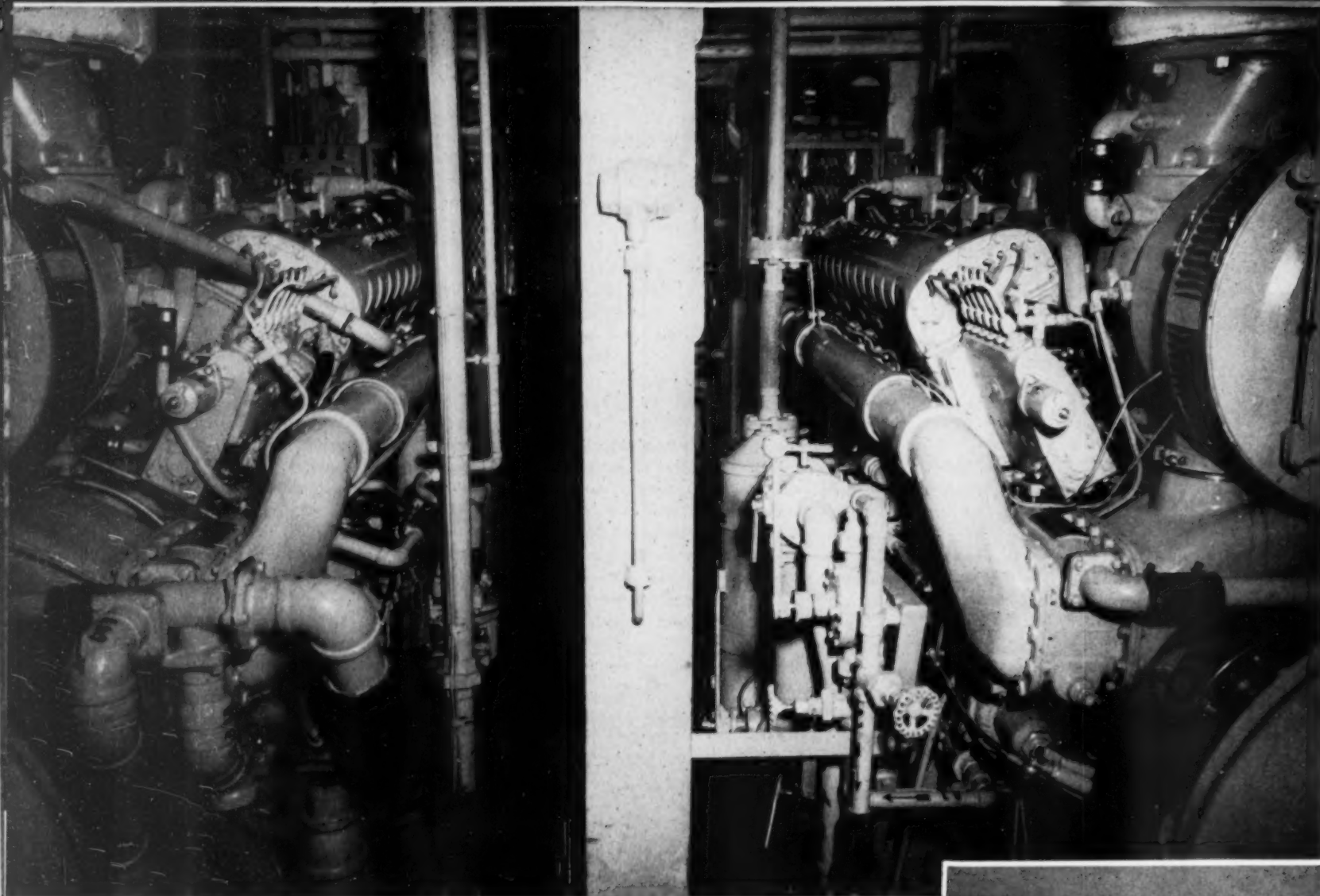
A Mann-Russell electronic heater and electronic press were used ingeniously to scarf glue wooden rib material into lengths upward of 70 feet, using white oak 6 inches wide. The specially designed gluing press, used to rapidly "cure" the waterproof resin adhesive, was powered by a Mann-Russell high-frequency generator with 5 kw. output, widely used in the plywood, furniture and millwork industries. These units are products of Tacoma's Northwest Syndicate, which does a unique international business.

Outside is planked with two separate layers of 45 degree diagonally laid fir planking, which has first been treated with the Wolmanizing process to make it impervious to worms and marine borers. Red oak planking 3 inches thick below the waterline and 2 1/2 inches thick is laid outside the pair of inner layers of diagonally laid planking and outside of this is a layer of red oak sheathing 1 inch thick, likewise treated for protection against decay or marine borers.

Because of the extensive mechanical layout and the large crew quarters necessary for normal operations, the whole interior of the ship is

The shipyard crew of the J. M. Martinac Shipbuilding Corporation, Tacoma, Wash., who built the *U.S.S. Endurance* and who are now engaged in building eight similar ships.





Inboard pair of Packard diesels looking forward in aft engine compartment. Note General Electric turbochargers, Bosch fuel pumps, Purolator strainers.

heavily compartmented and there is sufficient watertight bulkheading to the main deck, including watertight doors, to make it difficult to completely sink the vessel even under the most severe conditions of service. Their function, to clear the sea lanes of mines for passage of larger ships, requires the most elaborate control and interlocking systems on any ship type outside of submarines. Installation of the remote control systems alone is almost as costly and time consuming as the general routine of outfitting. The most interesting phase of course, is building everything as nearly non-magnetic as possible. Substitution of non-ferrous metals gives rise to unusual thicknesses of metal and the most unusual usages of every non-magnetic substance including plastics. Since the ship is equipped to detonate every known type of mine, the complex equipment; plus the elaborate communications system both internal and external, it is not difficult to understand why costs go beyond \$6,000,000 apiece for the ships.

Shafting, hull fastenings, machinery base castings, stairways, galley equipment, piping, plumbing fixtures, cable and even anchor chains are evolved as near non-magnetic as possible. Tanks are of bronze, as are the air bottles. For long sea duty, even the large Badger distillation plant, as well as the special design Cyclotherm heating boilers are of non-magnetic construction. Even the space in the galley where canned food is stored, has a special degaussing coil encircling the area. And the construction of refrigeration equipment, muf-

flers, heavy gears and shafting to produce as near zero magnetic effect, not to mention the cast bronze rudder and anchor, of all things, was a supreme test of ingenuity of the suppliers who labored to make the ships unique in their field for all time and in all countries. The amount of metal outside coils in motors and generators, that is of iron, has been reduced to practically zero, yet where iron could not be substituted, elaborate degaussing is built around or inside of every piece. Ships wiring is even sheathed in woven non-magnetic flexible tubing, and Packard has reduced its famous 142 engine design to what the future in U.S. industry may require as "normal" when steel reaches \$400 per ton.

The Power Plant

Basically the *Endurance* was designed to carry not only adequate power for operation in all kinds of sea, but to provide extreme flexibility right along with light weight dependable prime power in multiples, in case anything failed in action. A merchant ship can stop and make repairs. A minesweeper leading an attacking fleet into an enemy harbor cannot fail or stop in a crucial moment. Therein is the basic difference and the so-called "mystery" as to why anything for the Navy is so vastly more complex and expensive than a ship for civilian use.

The power plant of the *Endurance* consists of a total of nine diesel engines divided as follows:

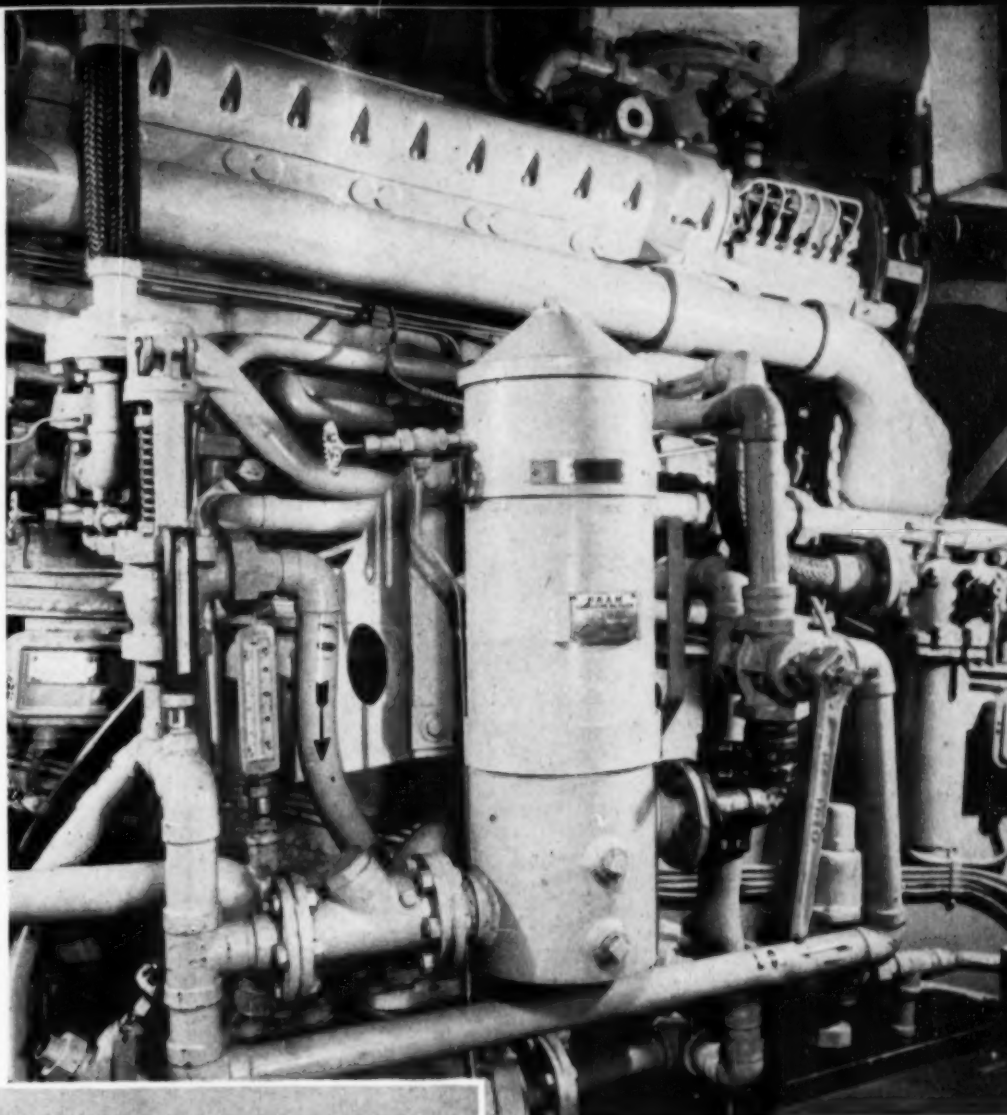


Six Packard Class 142 twelve-cylinder 600 hp. engines developing their rated output at 2000 rpm.; one Packard Class 142 six cylinder diesel engine developing 275 hp. at 1800 rpm.; one Detroit diesel, developing 100 hp. at 1800 rpm. (4 cylinder GM unit); one 5 hp. Hallett single cylinder 4 cycle emergency diesel.

To clarify the complex definition of "main engines" briefly, the special purpose (degaussing) electric load, plus the regular ships service electric load almost exactly equals the main propulsion load.

The six Packard 600 hp. diesels are employed as follows: Four are arranged in two pairs in the aft engine compartment to drive two propellers through hydraulic couplings and Westinghouse single reduction gearing. Of these four main Packard engines, the two outboard propulsion units also carry on their shafts one of the special purpose generators which rotate merely as flywheels when underway. These two units can be quickly uncoupled from the Westinghouse reduction gear by dumping the American Blower hydraulic coupling, and instantly put on the line for mine sweep duty. The remaining pair of Packard 600 hp. 12 cylinder diesels are in the forward engine compartment and are for special service

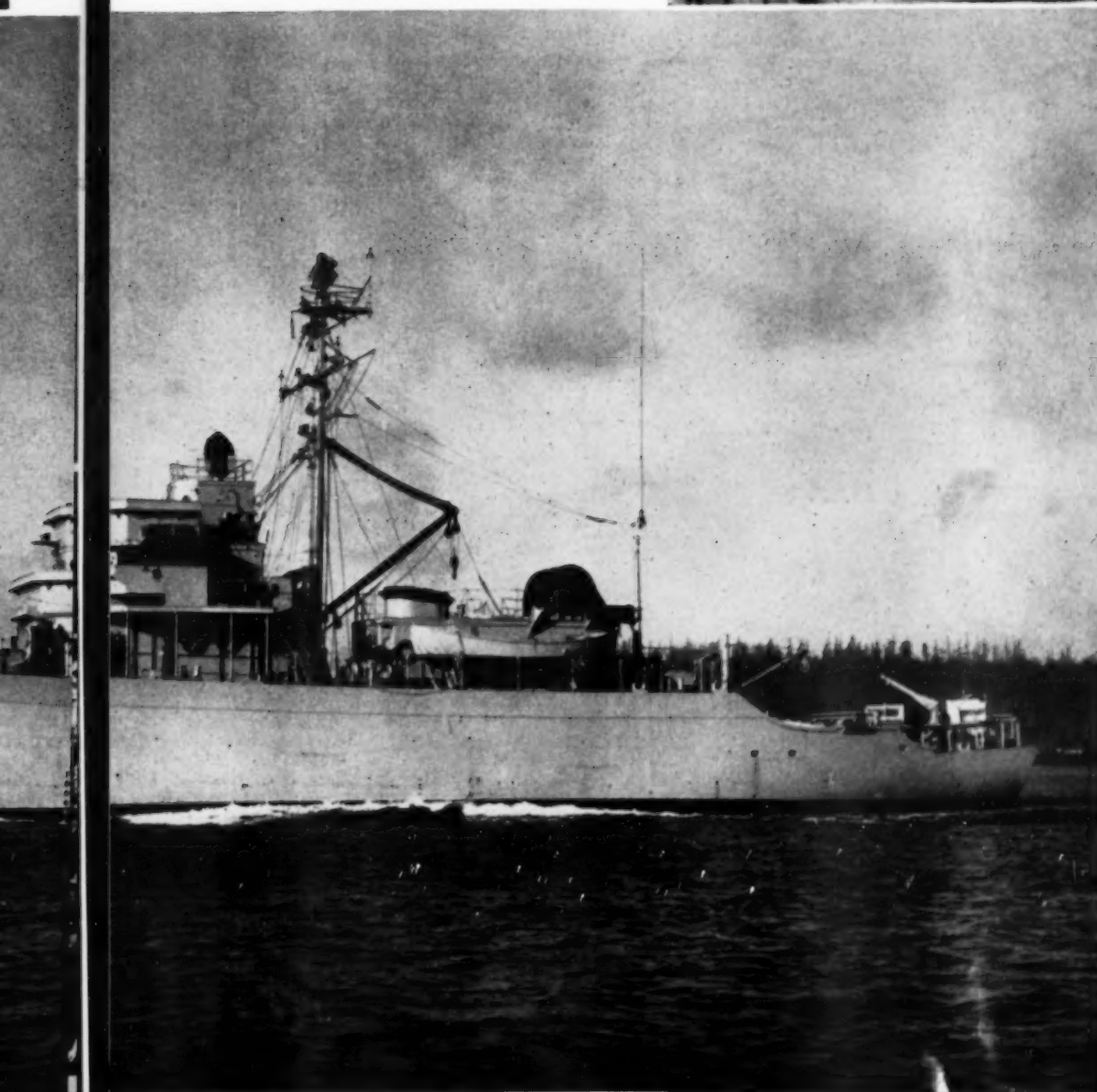
Broadside view of U.S.S. *Endurance* on trial run in Tacoma harbor. She has nine diesels aboard, seven Packards, one Detroit model 71 and one 5-hp. Hallett diesel.

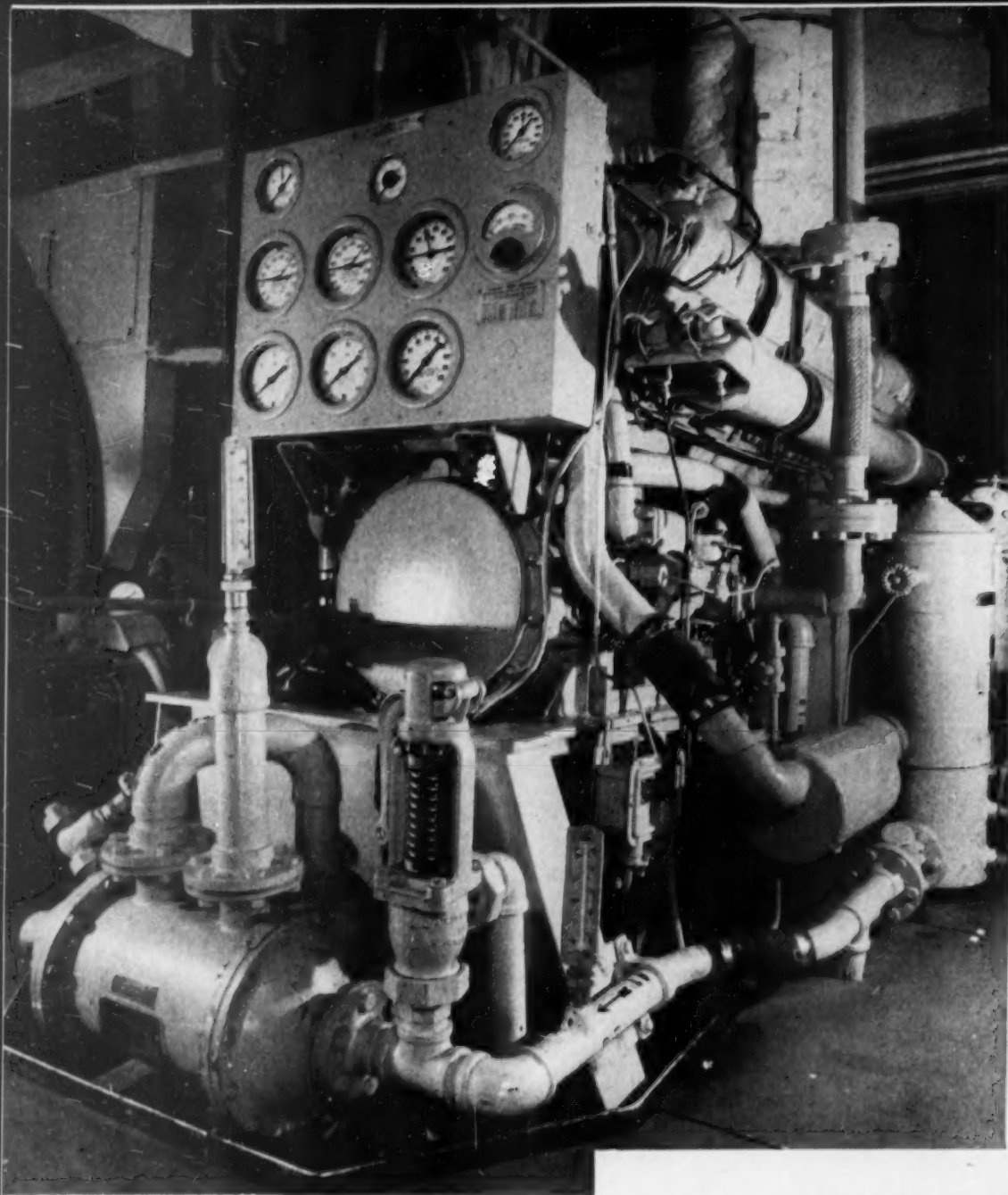


Auxiliary side of one of the six Packard 600-hp. diesels. Center, extreme left, is Detroit Controls hot oil alarm control. Bottom left is Harrison oil cooling heat exchanger. Center is Fram oil filter and extreme right is Puro-lator lube oil strainer. Flexible tubing shown is by D K Manufacturing Co.

generator propulsion only. Here again, each drives a different type of generator unit. A total of three Packards drive the ordinary magnetic mine sweep gear, the fourth a new type of sweep gear embodying an elaborate pulsating system that is combined electric and hydraulic. Thus out of the six main Packard diesels, up to four may be used for propulsion; a total of three for one type of sweeping operation and a total of four for both types.

Obviously all this multiple use and extreme flexibility cannot be done without very elaborate control systems both in the pilot house and in the engine rooms, in addition to elaborate driving mechanism which can be cut in or out instantly. The seventh Packard unit is simply a straight ships service generator unit, consisting of a 6-cylinder in-line Packard diesel, Series 142, driving a 185 kw. 450 volt Westinghouse ac. three phase generator for use when operating cable winches, deck machinery and general heavy duty "in action" service. The eighth diesel is a 4-cylinder General Motors-Detroit Diesel Division series 71 engine, developing 100 hp. at 1800 rpm. and driving a 60 kw. 450 volt 3 phase ac. generator, with ample capacity to supply ships service when running at sea, but without extra winch and deck machinery load. Ninth diesel is the little 1-cylinder, air





Front end view of one of inboard main Packard diesels in aft engine room. Lower left, the Harrison lube oil cooler with Atlas spring relief by-pass valve. Switchboard has Alnor pyrometer middle right. Tall cylinder in rear, extreme right, is Fram oil filter. Detroit controls at right center. Note at the end of the air intake manifold center right the two Chevron pressure primer system installations used to inject Chevron priming fuel into the engine for quick starts in all weather.

cooled Hallett 4 cycle engine driving a Kurz & Root generator with rated output of $2\frac{1}{2}$ kilowatts, 115 volts ac. for emergency use in signaling and running lights only. This is located in the stack atop the deckhouse. This unit develops $5\frac{1}{2}$ hp. at 1800 rpm. and has cylinders $3\frac{1}{2} \times 3\frac{3}{8}$ bore and stroke and is self contained as to fuel and lube. Simplicity in itself as there is no water cooling system or elaborate radiators and fans etc. The flywheel is the cooling fan.

To keep the electrical system continuity intact, there are three 25 kw., 115 volt Westinghouse transformers to cut in on the 450 volt ac. power and provide for ships lighting circuits; as well as two Surette storage battery sets for emergency power, one 12 volt and the other 24 volt, for emergency radio, signal and communications use.

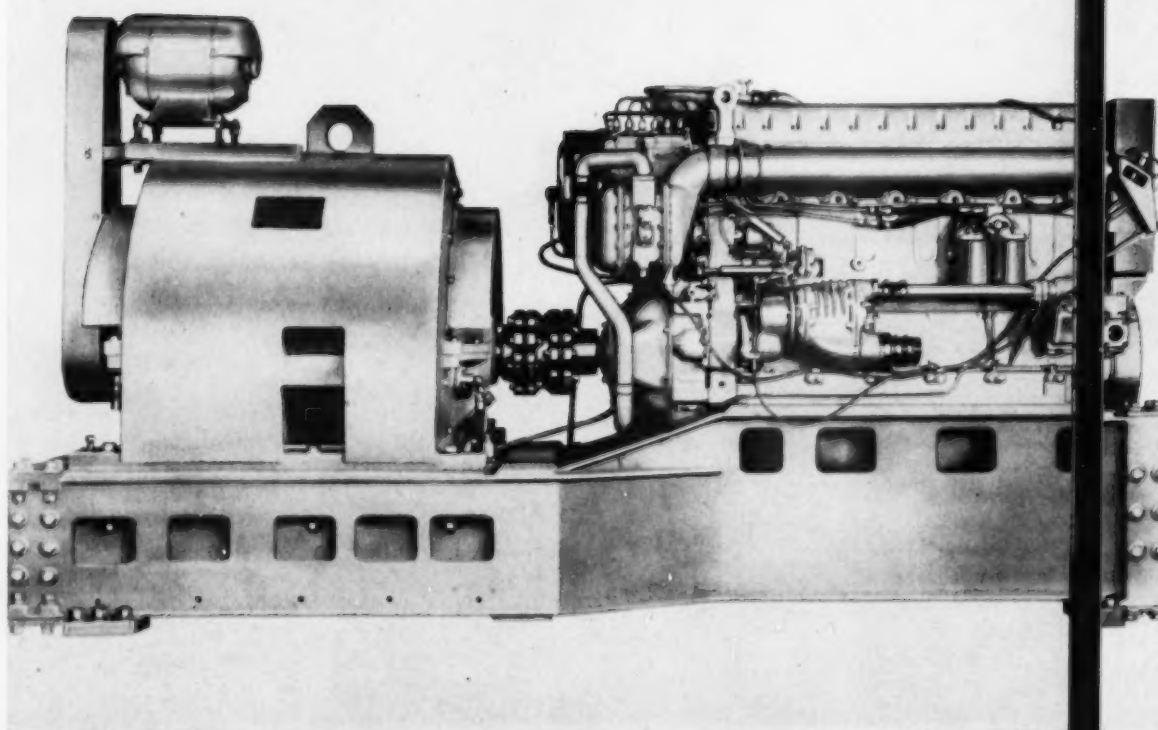
The Packard Series 142 Diesels

Though the special Navy type, extreme lightweight Series 142 Packard diesels have been on the market for the past 18 months, it is only now that they are getting set on the jobs they were designed for. Prime point of interest, beyond their efficient mechanical design and compactness, is their very light weight. Prior to this Packard series a lightweight diesel was considered in the 16 to 20 lb. per hp. range, with many of its components being ferrous metals. The new 142 Navy type series brings weight straight down to aircraft limits, the 12-cylinder 600 hp. model having a dry weight of but 5.51 lbs. per hp. and the 6-cylinder model a dry weight of 7.31 lbs. per hp. Dry weights complete are 3308 and 2195 lbs. respectively.

Using their long background of automotive engine building and even into the diesel aircraft engine field, Packard has produced in the Series 142 a design of 4-cycle supercharged engines embodying extreme light-weight, extreme interchangeability of all parts and based entirely on a cylinder of fixed 142 cu. in. displacement regardless of the engine size. The V-12 and its sister engines all develop maximum output at 2000 rpm. and have $5\frac{3}{8}$ bore and $6\frac{1}{4}$ in. stroke. The 600 hp. Packards on the *Endurance* all have engine blocks 30 in. across the top; just under 48 in. long and $27\frac{1}{2}$ in. high.

The utilization of complex castings throughout the design calls for production techniques of a high order. The entire cylinder block, pistons, oil pan, intake and exhaust manifolds, valve covers, timing gear case, accessory housings, turbosuperchargers etc. are all cast or fabricated from aluminum alloys and the unique cylinder heads are pre-

Standard 6-cylinder Packard diesel arranged for ac. generator drive. Thomas flexible coupling between engine and generator. Harrison inter-cooler top center. Leece-Neville air starter.



cision cast of high heat resisting alloy steel. Dual camshafts run atop each cylinder bank, one for intake and one for exhaust valves, and the valves themselves are stellite faced, and the exhaust valves are sodium cooled.

Fuel injection is interesting in that the Bosch injector sprays fuel into a small pre-combustion chamber located in the center of the cylinder. Thus peak pressures occur within this spherical chamber instead of in the top of the cylinder. This ignited mixture sprays down to the top of the piston, where a special dome shape crown or cone disperses it in all directions creating high turbulence, thus assuring clean burning at all speeds. This system lowers the maximum pressure on the piston, hence lessens peak load on the bearings and crankshaft, making the lightweight construction safe and practical, and lower pressure fuel supply lines to the injection nozzle in the pre-combustion chamber. Forged aluminum pistons with five rings, four above the pin and one just above the bottom of the skirt are employed. Four valves per cylinder, two intake and two exhaust are used, using damping type nested valve springs, caged in cylindrical barrels integral with the valve guides. All valve seats are stellite faced. Wet type cylinder liners are employed and the constant stroke, multi-plunger Bosch design, with a separate hydraulic governor. Connecting rod bearings are $3\frac{3}{4}$ size, and the camshafts are mounted on plain bearings and of carburized steel.

Compression ratio is 15 to 1 and the stainless steel crankshaft is surface hardened and counter-weighted, and run on seven steel backed silver plated bearings with thin coating of high lead tin to protect the silver plating from scuffing. Pressure

lubrication is used throughout. The turbosupercharger is arranged to receive hot exhaust gas in four groups, through an inner insulated steel manifold, the outer covering of which is water jacketed, thus keeping the exhaust gases hot before losing their power to the turbine, yet the engine room cool. An after-cooler reduces engine air temperatures before entering the intake manifold. Harrison lube oil heat exchangers are fitted into the circuit, with Fram lube oil filter and Purolator edge type strainer. Fram and Purolator fuel oil filters are used. Starting is by a compact Leece-Neville compressed air motor with a gear ratio of $6\frac{1}{2}$ to 1 for the 6-cylinder engine, 13 to 1 for the 12-cylinder engines and operating through an automotive type Bendix drive. Exhaust from the starting motor passes to atmosphere through a cylindrical stainless steel muffler at the base of the engine.

The lube oil pressure is controlled by a pressure relief valve ahead of the oil cooler, and there is a Detroit Controls Co. low oil pressure alarm system as well as a high jacket water temperature alarm system. A remote control Ross air valve is set into the starting air line so it can be operated from the main engine control console. It is thus clear that the very design of this Series 142 diesel lends itself perfectly to use aboard non-magnetic minesweepers. The use of ferrous metal is confined to rings, heads, connecting rods, camshaft, crankshaft and valves; everything else non-magnetic non-ferrous metal. Ross fresh water heat exchangers are used with engine water pump mounted outside, on the lower edge of the crankcase, and completely Amot thermostatically controlled at all speeds and loads. American Motors (Amot) thermostats controlling the lube oil and jacket water temperatures are engine mounted on the 6-cylinder Packard and shipbuilder mounted on the 12-cylinder Packards. Crankcase vapors are automatically

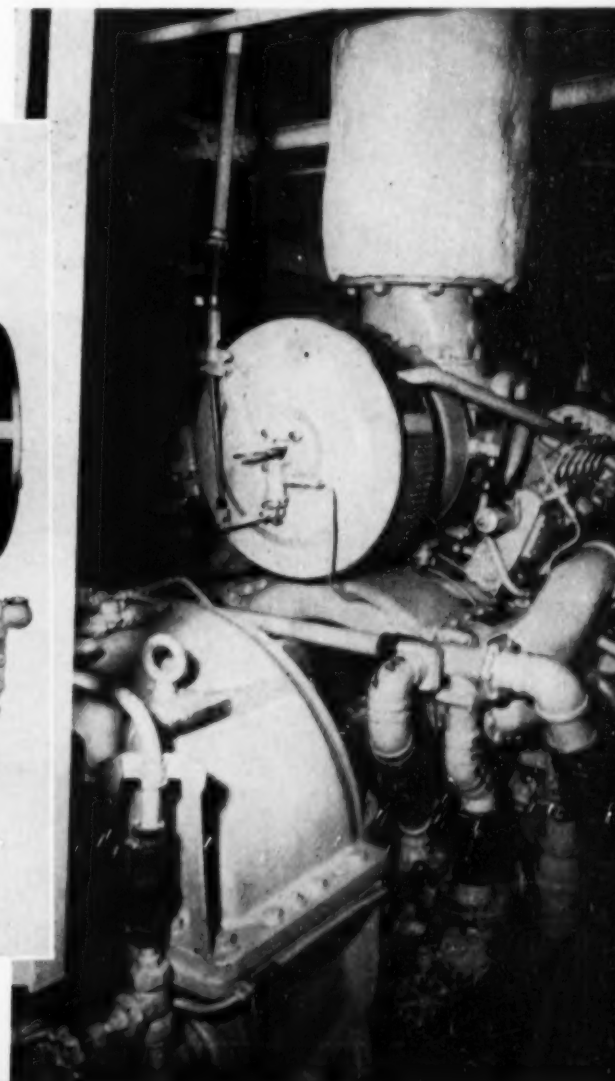
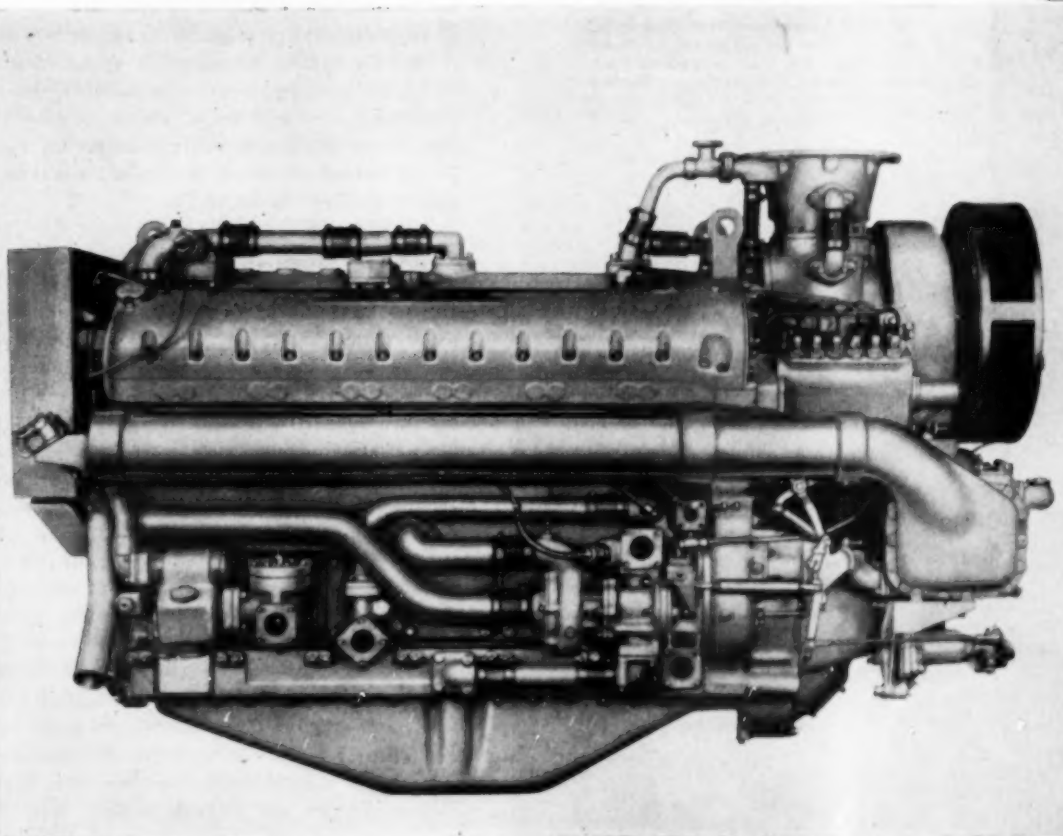
drawn into the turbocharger intake in sufficient volume to maintain a slight vacuum at all times, thus assuring safe operating conditions.

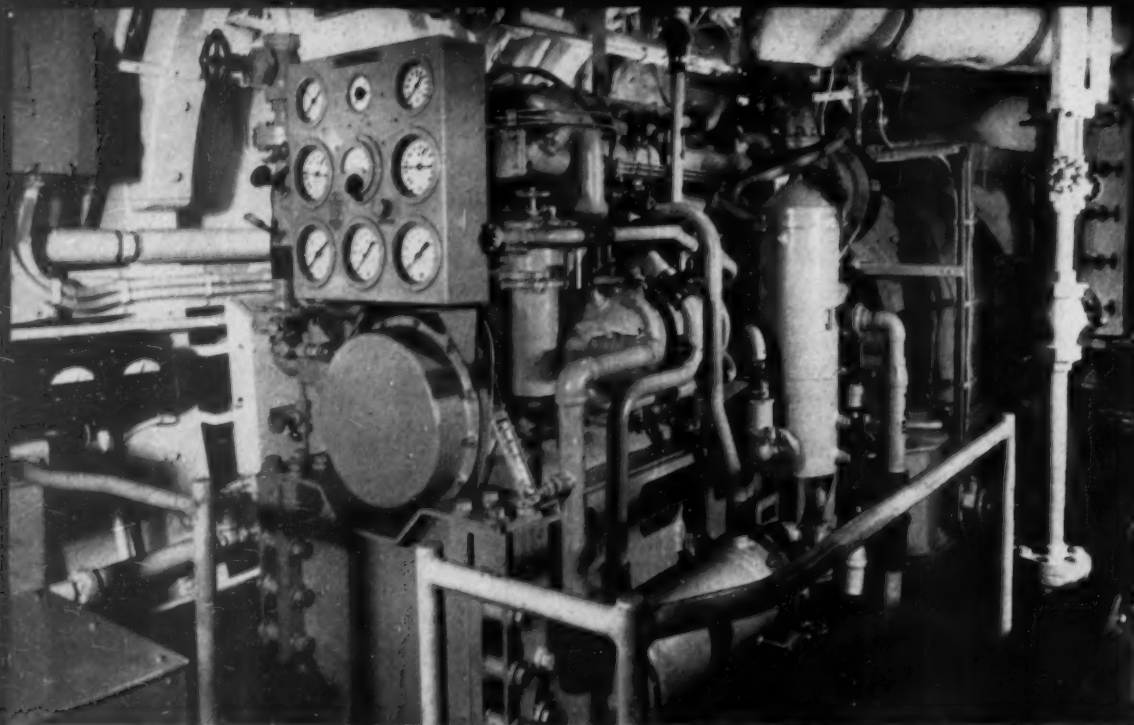
At every point on the ship, and more particularly in both engine rooms every effort is made to break continuous metal pipelines, whether they carry air, water, oil, lube or exhaust gasses, to minimize vibration. Where rubber tubing is not practical, a unique type of flexible metallic (non-magnetic) tubing is employed, made by D K Manufacturing Co. This tubing is used in the compressed air and water supply lines and exhaust lines. All diesels exhaust to a central stack, where a battery of Burgess Manning stainless steel mufflers are fitted of sufficient size to dampen noise and vibration even if all 9 diesels are running. Alnor pyrometers and Weston tachometers are fitted as well as Navy type Tayco thermometers in all lines where temperatures may be relevant.

Because of the unique job the *Endurance* has to do, she, like her sister vessels, must have an ingenious and compact dual control system—one complete set in the main engine room and the other in the pilot house, both for propulsion and the propulsion system as well. Packard Control Consoles are fitted in the engine room—a pair,

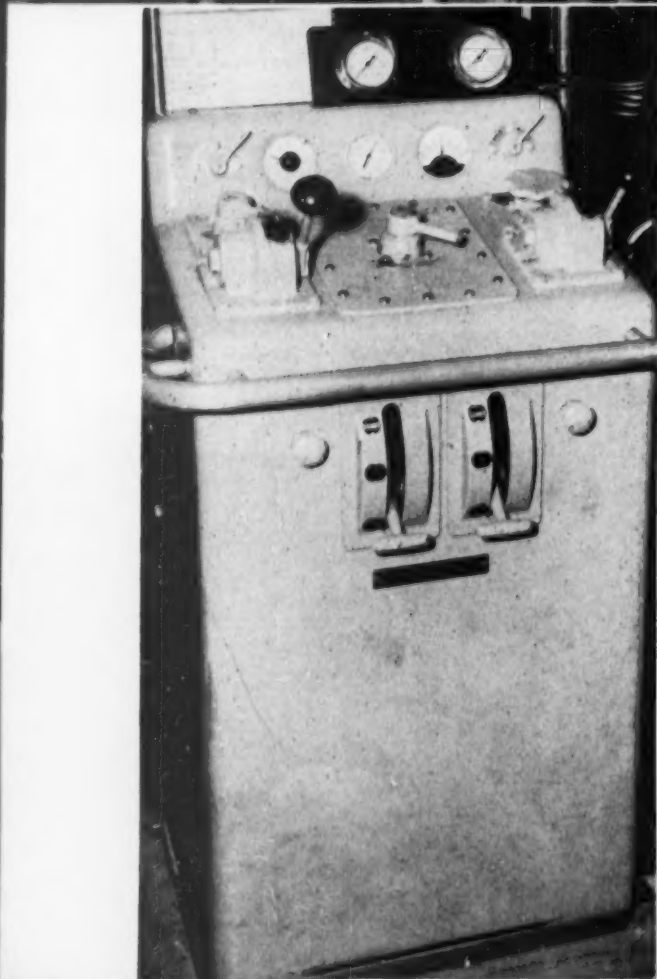
Rear view of one of six main Packard 600-hp. diesels showing turbocharger assembly, crankcase ventilating feeder and Harrison aftercooler. One of three special purpose (degaussing) generators lower left. These are Westinghouse units. Westinghouse coupling (one of four on the ship) under the turbocharger. Note La Favorite rubber flexible connections on all piping.

The standard 12-cylinder, 600-hp. Packard diesel arranged for connection to propulsion gearing.



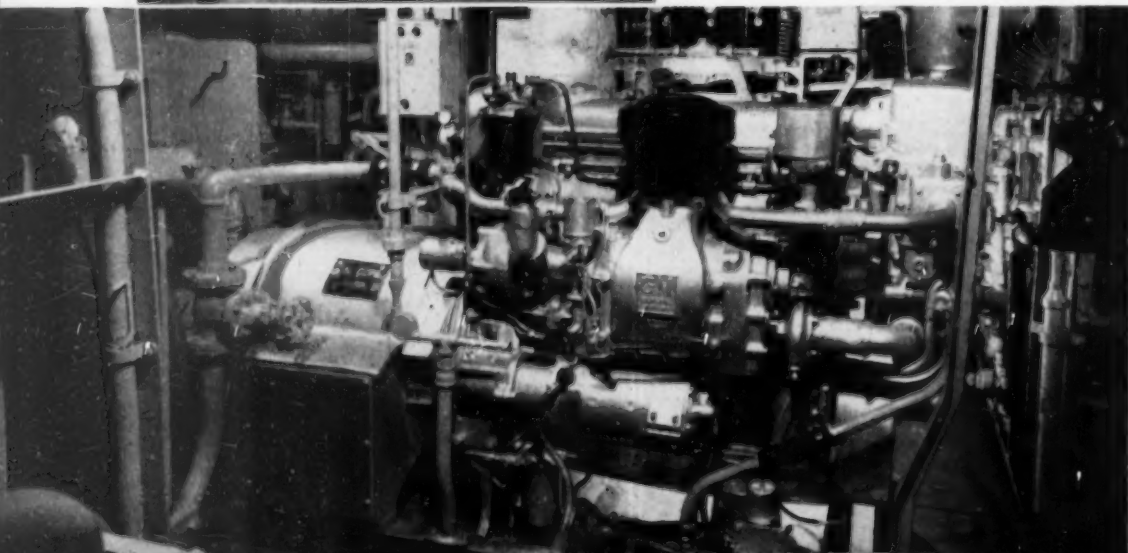


One of outboard Packard 300-hp. 6-cylinder diesels, showing special purpose generator coupled to shaft, between diesel and reduction gear, Purolator lube strainer to right of switchboard. Note aluminum box-girder base mounting. Amot thermostat to right of lube strainer. Ninety-nine per cent of everything in this shot is non-magnetic construction.



One of the twin control consoles in aft engine room with Westinghouse Controlair control systems on top. Panish main engine controls on front of the console. Each console controls two main Packard diesels, one of which is for propulsion only and the other for both special purpose (degaussing) generator drive and propeller drive through the Westinghouse gear. These control consoles are synchronized with the pilot house console so that either the navigator or engineer on watch can control the four propulsion Packards. Engineer also regulates generator operation when these are cut in during sweeping operation.

General view of forward engine room of U.S.S. *Endurance*. Foreground is the 60-kw. Detroit Diesel General Motors ship's service generating set. Right rear is Badger non-magnetic water distiller.



each one serving 2 main diesel sets and a Henschel single dual unit in the pilot house, so the navigator can stop, start, reverse and alter speed in either direction in a matter of seconds without waiting for the engine room telegraph system to respond. Westinghouse Controlair controls are fitted on the Henschel consoles on the pilot house, while Panish controls are used on the two 600 hp. and one 300 hp. straight generating set installations.

In the forward engine room, where two of the 12-cylinder Packard diesels are situated, entirely devoted to driving special purpose generators, the 6-cylinder Packard ships-service unit is also located. This engine in every respect, except the number of cylinders is like the six larger units. Of 6-in-line design, it is mounted as a complete unit, including heat exchangers etc. on a channel base, which also supports the 185 kw Westinghouse ac. generator. Because of space limitations, two of the four diesels in this compartment are mounted on high aluminum channel base. The ships service unit occupies one side while the smaller ships service unit is located in the center. As in the aft engine compartment, the fresh water heat exchangers are fitted below floor level and accessible through removable aluminum grating. As with everything else, these are non-magnetic, and made of copper and brass, including all valves.

The Detroit Diesel 4-71 Engine

This compact unit is designed to operate alone while the ship is at sea on long voyages or on runs where no use of the mine sweep gear is indicated, and is of sufficient capacity to operate the clock around, without pause. The 4-71 GM diesel has 4½ in. by 5 bore and stroke and has electric starting, and all accessories directly connect. It drives a 60 kw. Delco ac. generator delivering current at 450 volts, 3-phase. Current from both this and the larger Westinghouse ac. supply are handled through the main ships switchboard in the aft engine room. Dry weight of the engine is given at 1380 lbs. without accessories, or approximately 13 lbs. per rated hp. However, many of the cover plates and accessories are of aluminum alloy to conform to the non-magnetic requirements that prevail throughout the entire installation so exact weights are hard to determine.

Ship's Propulsion Drive

Getting back to the aft engine space, the four main Packard diesels have a dual job. One, or all four or any combination can be cut in or cut out at will, to swing either or both propellers through the elaborate Westinghouse drive. The two outboard engines with their special service generators rotating on the main shaft at all times, can be instantly disconnected from the Westinghouse drive system and cut into the power supply for mine sweeping operations, leaving the two remaining Packard units to propel the ship under slower conditions while playing out the sweep gear. To accomplish this, one of the most complex drives ever used in a diesel vessel has been installed to produce almost identical flexibility to that comparable to a diesel-electric drive of more conventional design. Naturally to minimize production of stray magnetic currents, the fewer electric motors and controls aboard ship the

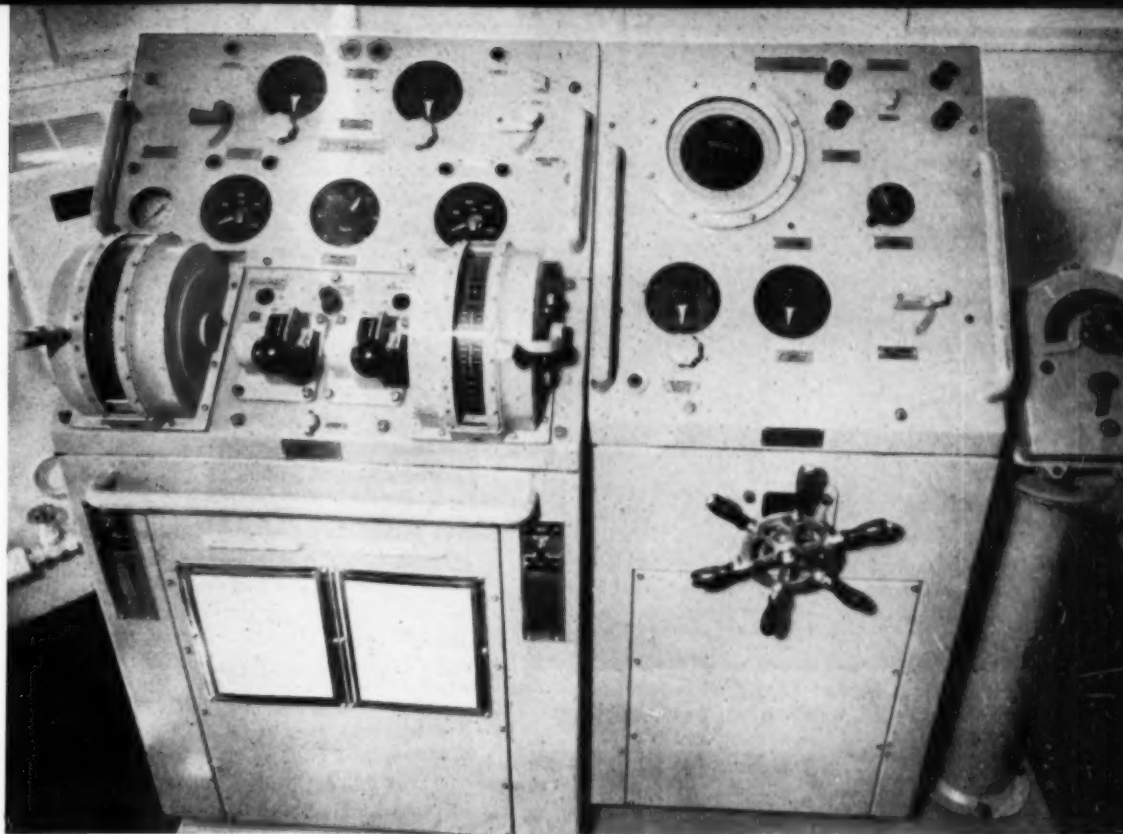
better. Hence the extraordinary design of the propulsion system to give the instant response, silent, vibrationless characteristics, plus the extreme flexibility of the electric drive.

Following from the end of the Packard diesel drive shafts they enter the American Blower hydraulic couplings. These are supplied by a small Vickers pump; A. W. Cash regulating valves; Ajax oil control valves and a battery of Maxwell Manning-Moore thermostats to keep the oil at proper temperature and the main Westinghouse gear case cool and lubricated. To disconnect a unit, oil is bled off the couplings which allows the pinion gear and shaft on the Westinghouse reduction gear to idle freely on one side and the driving shaft to rotate at different speed on the other, which it would, when power is turned on the special purpose generator. The main twin pinion Westinghouse reduction gear is designed to handle 1200 hp. and the ratio is 5:98 to 1 on the propeller shaft. This gives the propeller a 325 rpm. maximum.

A special Kingsbury thrust bearing is fitted and the main shaft, which runs through the gear case, runs into a special fitting for operating the hydraulic variable pitch propeller controls. The shaft and propeller assembly, starboard and port, were furnished by S. Morgan Smith Co. and consists of a hollow shaft extending from the reduction gear back to the propeller, with another shaft running inside. The propellers are four bladed variable pitch design and are seven feet in diameter. Control of the pitch is accomplished in the hub through a Bendix Variable Pitch control unit, powered from the hydraulic system and the Allen Cardwell hydraulic controls. These in turn are operated directly from the pilot house through two levers and half-circle gauges, to fix and determine the pitch of each wheel at a glance.

The high pressure Vickers pumps supply the system, so that the navigator on the bridge, by watching his engine overload indicator and speed indicator, can smoothly change pitch of each propeller from full ahead position to full reverse position right up to the momentary overload capacity of the Packard diesels; two or three seconds from full ahead to full reverse if the man at the controls in the main engine compartment watches his diesels carefully. Ship is taken up in the American Hydraulic couplings, so that ordinarily with both diesels on each shaft working properly the sudden overload will not kill the diesels even in almost instantaneous maneuver. The hydraulic controls of the variable pitch mechanism work smoothly through the long shaft, which is of monel alloy and oversize to take the sudden strains, and provide lubrication at the same time. Mechanically the system though somewhat complex, is the nearest thing to an extra-size (for overload) complete diesel-electric propulsion system that has ever been devised.

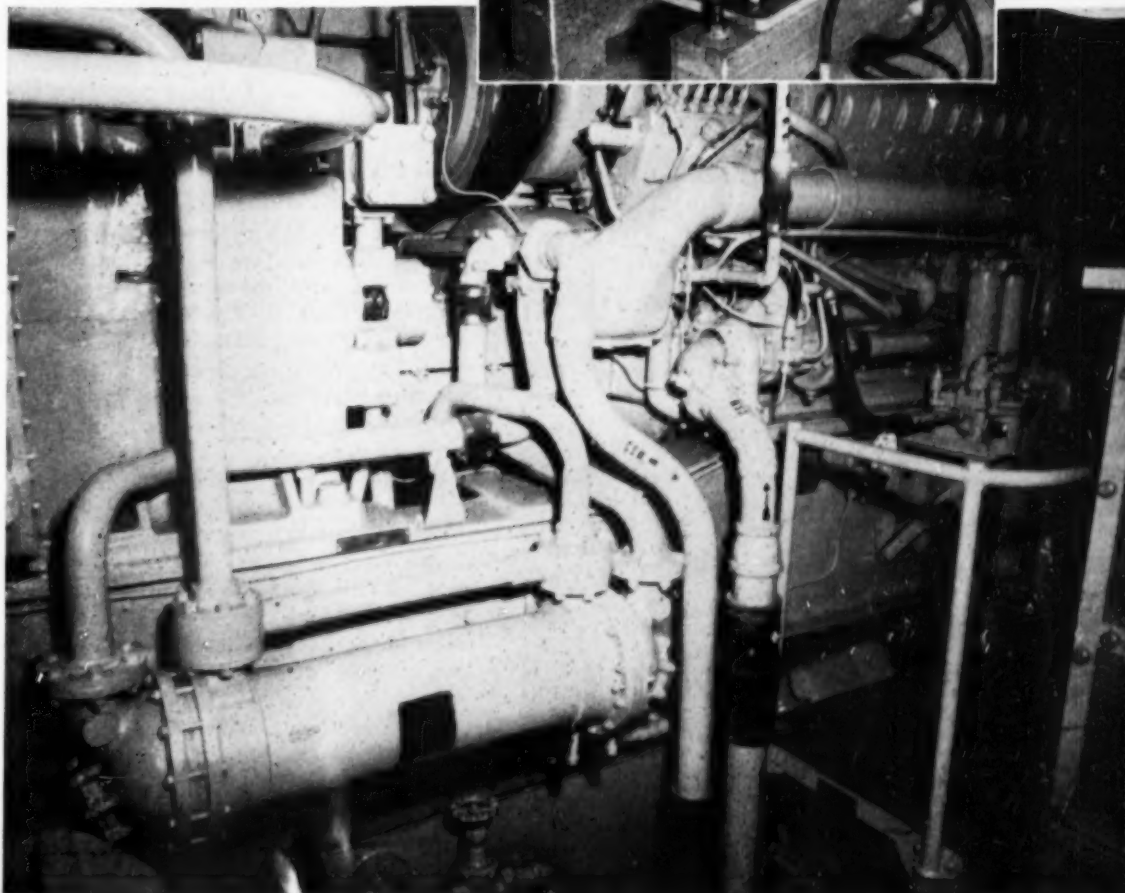
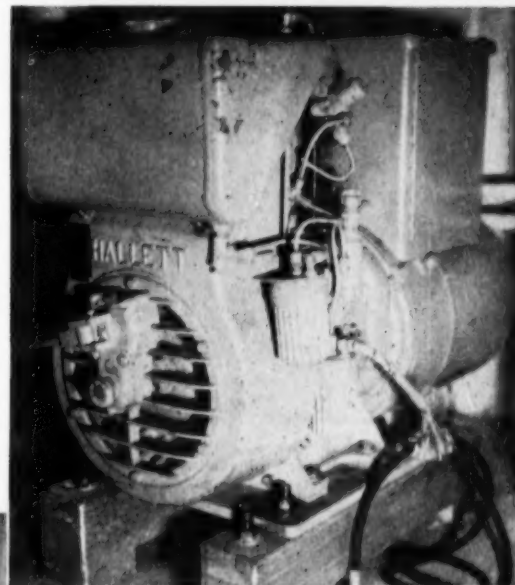
While many small pieces, right down to a pair of Ross lube oil coolers to keep the oil cool in the system, make up the variable pitch system, actually it is less bulky and the controls a third the size of comparable switch gear necessary on the all-electric drive. But this is academic. Electric drive on ships like the *Endurance* would only add more

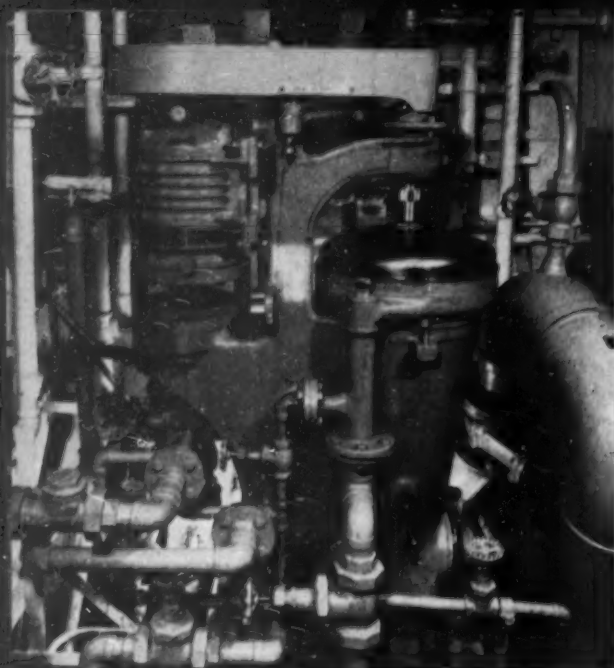


Twin Henschel control consoles in pilot house. Left contains twin variable pitch propeller controls. Quadrants with high handles to right and left are the Allen Cardwell variable pitch propeller control levers for starboard and port props. Two round control knobs in center are Westinghouse Controlair engine speed controls. Right hand console is Henschel navigation controls, with standard navy gyrocompass repeater, helm angle indicator and steering wheel controlling the American Engineering Company electro-hydraulic system.

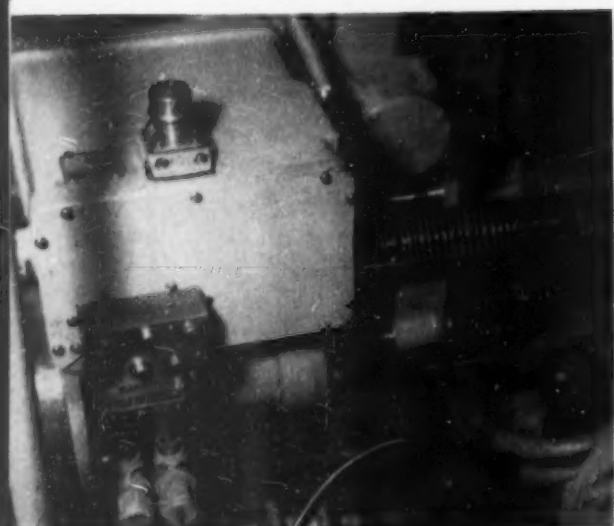
Hallett 5-hp. auxiliary diesel generating set installed in the stack.

Broadside view of variable frequency generator with one of 600-hp. Packard diesels, together with business end of Vickers pump unit used for pulsing. At bottom is special Ross heat exchanger for Vickers pump circuit. Right center is Purolator duplex fuel oil filter.



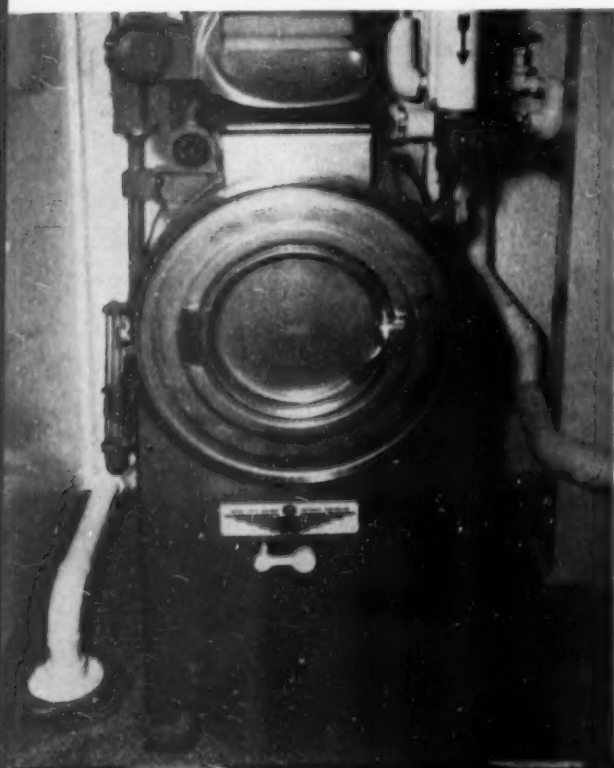


Sharples diesel fuel oil purifier on U.S.S. *Endurance*.



One of the two Allen Cardwell hydraulic propeller pitch variation control units. This is fed by a Vickers pump. The measuring rod at the right indicates position of propeller blades at all times.

U. S. Hoffman washing machine to handle the crew's laundry, 100% non-magnetic.



destructive magnetic currents which would limit the usefulness of the whole ship and make it useless as a Naval vessel. The Navy, however, is anxious that there be available both electric and hydraulic drive for multiple-dieselized vessels, and that while European nations have gone ahead of us in diesel-hydraulic and diesel mechanical drives, this nation is superior in electric drive. And someday it may attain equity with Europe in the other two forms. So again, the *Endurance* is a forerunner of future possible trends in this field. The bronze rudder is by Capital Products, Inc. and the rubber stern-bearing is by Lucian Q. Moffitt, Goodrich products.

As a part of the elaborate hydraulic system for the propellers, there is also included as a separate part of the reduction gear and propeller control assembly (a complete set for each reduction gear) a Duplex oil strainer (Andale), one Imo lube oil pump and a Kewanee-Ross oil cooler.

The steering gear is by the American Engineering Company and is of single opposed ram electro-hydraulic link type with maximum use being made of bronze, brass and stainless steel in its construction to assure non-magnetic characteristics. The steering gear consists of a ram and cylinder group mounted on a single bedplate connected by links to a tiller on each of the two rudder stocks. Fluid power to actuate the rams is supplied by a power unit consisting of a 3-hp. constant speed motor driving a Hele-Shaw reversible variable discharge pump. The pump is controlled by a newly developed hydraulic servo unit incorporating full storage motion and floating lever follow-up, thus providing true fingertip steering from both the steering gear compartment and the bridge. Control from the bridge is accomplished by a separate electric control manufactured by the Bogue Electric Company consisting of a bridge unit with 10-in. diameter wheel and a magnetic amplifier rack and actuator unit located in the steering gear compartment. In the event of failure of electric power the vessel can be steered by hand from the steering gear room by a hand wheel operated drum connected by wire rope to separate tillers on the rudder stocks.

Elaborate Auxiliary Features

Obviously with much of the equipment features of the ship closely tied to the special work she was designed to do, it is not possible to pinpoint everything. The deck equipment is some of the largest power-driven, specially built of non-magnetic metals, ever placed on a wooden vessel. The big 4-drum winch for handling sweep gear for example, by Almon A. Johnson, Inc., who furnished the non-magnetic combination mine sweeping winches and automatic towing machines (designed to conserve valuable space on deck, the two units were coordinated into a single piece of equipment); the towing winch by Hyde Windlass Co. with capacity of 3600 ft. of cable and attached gypsy with speed of 3200 ft. per minute; and the Ideal anchor windlass that hauls the oversize non-magnetic stud-link chain aboard from two sides, attached to which are the cast bronze anchors. Two other Ideal units are aboard, a magnetic cable reel winch (located on the main deck mid-ship) and a special device reel. All are of special interest on this ship because every component had to

be re-thought out and constructed out of anything except iron or steel. Only the coils in the motors have a trace of iron. Cutler-Hammer controls are used on the deck machinery. Back in the engine compartments, on the upper grating of the forward engine space are the twin non-magnetic Cyclotherm heating boilers, with power fans and burners and full automatic controls. One is normally used and two in the cold northern winters.

Because of the great amount and variation of electrical demands, there are a total of ten different switchboards of various sizes and capacities, installed. They were products of various manufacturers including Cole Electric Products Co.; Federal Telephone & Telegraph Corporation; Royal Switchboard Company; General Electric Co.; Westinghouse Electric Co.; Jacksonville Metal & Plastics Co. and Zinsco Electric Products Co. A special Sharples fuel oil purifier is fitted, through which all diesel fuel passes from storage to day tanks. This has a capacity of 250 gallons per hour and is driven by a 2-hp. motor. An Imo rotary pump with capacity of 275 gph. driven by a 2 hp. motor is fitted to supply the Sharples purifier. And as a part of the remote control valve system, Stow Mfg. Co.'s remote control valve gear is fitted.

To supplement nominal fresh water supplies for the crew, particularly on long ocean voyages, an elaborate, almost totally non-magnetic Badger water distilling unit has been fitted, with a capacity of about 2000 gallons per 24 hours. It is a model X2 with total electric heater capacity of 13.8 for the 12 submersible electric heaters used for starting. This unit features application of well known laws of physics and uses the vacuum-pressure-heat transfer system of boiling sea water at low temperature and mainly relying on the heat of compression generated during the process of compressing low temperature wet steam. A Cleveland Diesel Division (GM) 7½ x 8 inch 3-helical lobe positive displacement blower, turning at 1740 rpm. by a 15 hp. motor does most of the job. A Fisher & Procter Brine Rotameter, Westinghouse Ammeters and Ward Leonard magnetic relay switch with Detroit Controls pressure switch comprise the major list of controls for the Badger unit.

Elaborate Pump Installations

The long list of necessary pumps and accessory equipment to assure smooth functioning of the main machinery and to supply ships services in the best passenger-vessel style, include the following:

- 1—Worthington centrifugal fire pump, 100 gpm. at 100 psi.
- 2—250 gpm. 100 psi. Worthington main fire pumps driven by 25 hp. motors
- 1—centrifugal Warren Brine overboard pump
- 1—Warren condensate pump (Badger distiller)
- 1—Warren evaporator feed pump
- 1—Worthington condenser booster pump
- 1—Aurora fresh water centrifugal pump
- 1—Goulds refrigeration condenser S. W. circulating pump
- 1—salt water Goulds booster pump
- 2—Viking rotary pumps
- 1—Viking diesel fuel transfer pump
- 2—De Laval rotary pumps

- 3—special Vickers high pressure oil pumps
- 1—special variable delivery Vickers pump (1400 psi. 400 gpm.)
- 2—Tokeheim emergency fw. pumps
- 2—Sawyer portable and submersible electric pumps
- 8—Deming lube and diesel oil hand pumps
- 2—water jet ejector pumps by Vita Motivator Co.
- 2—Taco hot water heaters
- 1—Ross condenser drain cooler

Miscellaneous Special Service Equipment

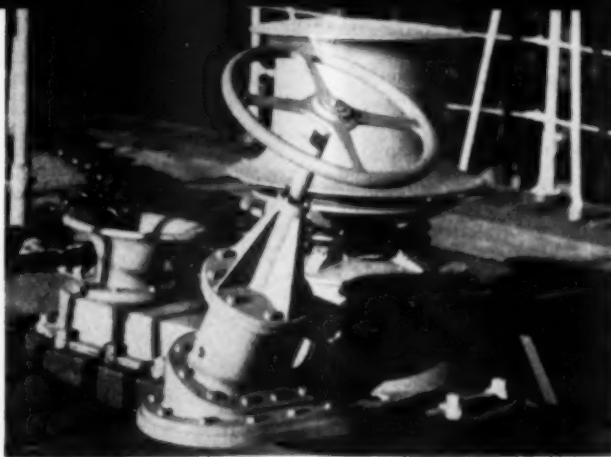
Two Gardner Denver model NTIC 10 cfm. air compressors are used to charge the four 15 in. x 96 in. stainless steel air bottles for starting the seven Packard diesel engines. These are automatic and work off the 450 volt ship's power circuit (which actually is 440 volts at the point of use). The main large ship's stores refrigeration plant, supplying the large walk-in boxes are supplied by two Carrier 2-cylinder model SF20 units driven by $\frac{1}{2}$ hp. motors. The shell and tube condensers are by Carrier also. There is also a small galley reach-in box supplied by a York unit. On the strictly electric side, the Westinghouse generators on everything but the two smallest diesels, are matched by Westinghouse control systems, including the 300 kw. variable-frequency generator with special Vickers hydraulic pump control system which creates the slow pulsations for the sweep gear.

Several suppliers of equipment on the U.S.S. *Endurance* have more than one model aboard, and in some cases two or more manufacturers are supplying approximately the same equipment. So the following short paragraphs will clarify some of these instances.

Panish Positrol Controls for remote hydraulic control on the U.S.S. *Endurance* include: remote start-stop-run and emergency trip controls for the propulsion plant (Packard T-3, T-4 twin units) and start-stop, throttle and emergency trip controls for the 185-kw. generator (Packard R-3); the magnetic M-S generator (Packard T-6); and the hydraulic pump A-unit (Packard T-5). The remainder of the hydraulic controls are Westinghouse Controlair units typified by the pilot house illustration.

All lube oil filters are Fram; all lube oil strainers are Purolator; the duplex fuel filters on the 6-cylinder Packard engine are Fram and on the 12-cylinder engines are Purolator. The whistles and the whistle controls were supplied by the Cunningham Manufacturing Co. Jacksonville Metal & Plastics Co. furnished all of the electrician test switchboards and all of the ship's service switchboards (except for 11) that were required for the non-magnetic minesweeper program. In addition, Jacksonville supplied name plates, card holders, cable tags, conductor markers and I.C. switchboards, all to the non-magnetic and high shock specifications.

Aluminum castings which are used to such a large extent throughout the vessel were supplied by the Aluminum Company of America and the Bohn Aluminum Co. Aluminum pistons by Alcoa. Woodward governors on all Packards. Air-Maze air filters on both Hallett and the seven Packards. Ermeto fuel line fittings from the Weatherhead Company. Piston rings by American Hammered Piston Ring division of the Koppers Co. Sodium cooled valves



Ideal anchor windlass on U.S.S. *Endurance*. Entire deck assembly is non-magnetic, including the twin anchor chains. Power drive through vertical shaft is from below deck.



View of American Engineering Co. electro-hydraulic steering gear controlling two rudders. Hand steering gear in background on bulkhead.

from the Eaton Company and vibration dampers from Houdaille Hershey. Wire rope by Bergen Wire Rope Co.; aluminum sub-bases for the Packard generating sets by Creamery Package Manufacturing Co.; and all camshafts on the Packards by Muskegon Motor Specialties Co.

The living facilities aboard, though scaled down in dimensions to almost submarine size, are complete to the last detail. Forced air ventilation, which includes 10 Vaneaxial fans by Joy Mfg. Co. and 14 McIntyre Engineering Co. air heaters (steam), plus elaborate lighting, intercommunicating and external radio reception facilities. The galley is fully mechanized and equipped with everything that can be made out of stainless steel, monel and aluminum—all non-magnetic, including the canned food degaussing coil mentioned earlier in this article. A power laundry machine is included. Fire protection throughout the ship is extraordinary, first because of the service conditions under which she will operate and second because she is of wood construction.

Besides the network of high pressure fire lines, a Hale fire pump liquid foam-maker guards the machinery spaces, and everywhere, outsize CO₂ non-magnetic fire extinguisher bottles of every size and shape of nozzle are placed on the ship. To meet the safety requirements, the non-ferrous CO₂ bottles are double the ordinary thickness and are mounted in aluminum racks for instant use. A tremendous amount of equipment for special duty in mine sweeping occupies many rooms aboard the ship, including a full-size machine and cable

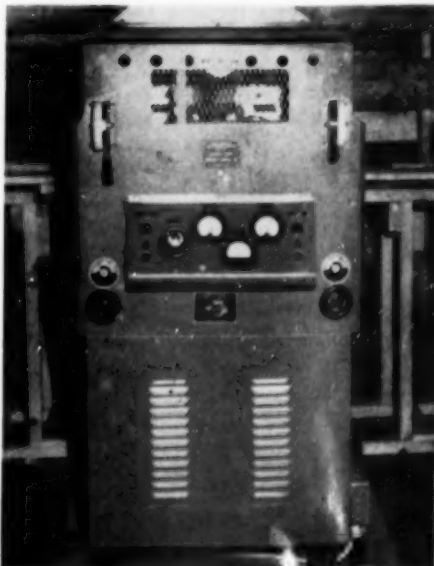
repair shop equipped with modern power tools. The communications system alone is worthy of the largest liner, as well as ships offices. A Task Force could be directed from the *Endurance* if no other larger ship was available, in case of emergency. But let's confine this whole restricted subject to a parting mention: she carries Westinghouse searchlights way up on top and a Raytheon Radar to help look for schools of fish!

The *Endurance* was built under the direct supervision of the Bureau of Ships, Capt. Linton Herndon in charge for the 13th Naval District at Seattle, and Commander Laurance Mackinlay in charge of the Tacoma Office. At commissioning and acceptance from the J. M. Martinac Shipbuilding Corporation, she was in charge of Capt. H. F. Agnew of Tacoma Naval Station, who turned her over officially to Lt. Martin as Commander of the ship. Working under Lt. Martin are Lt. John R. Kearney, as Executive Officer; Lt. Joseph B. Mosteller, Jr., Engineering Officer; Lt. Kenneth M. Curtis, Underwater Search Officer; and Ensign Alan R. Nicholson, First Lieutenant. A picked crew of 60 men sailed from Tacoma for the official shakedown cruise at sea.

So, the first AM Class minesweeper to win her Official Board Trials by the Navy with flying colors and practically no squawks, carries the flag for the Navy's determination to keep the world's harbors free of mines and open to all ships, and the flag for America's famed Packard Motor Company, responsible for building this truly lightweight marine diesel engine.

Photo credits: Exteriors by Ken Ollar, shipyard pictures by Richards Studio, detail pictures by Paul Ericson.

The Mann-Russell high frequency generator, left, 5-kw. output, used to power the special electronic scarf gluing press to rapidly "cure" the waterproof resin adhesive used in fabricating the laminated Douglas Fir and Southern Oak frames, horn timber, beams and stems of the U.S.S. *Endurance* and her sister AM-class minesweepers.



THE SAE PACKARD PAPER

By MARSDEN WARE,

R. E. TAYLOR and J. WITZKY

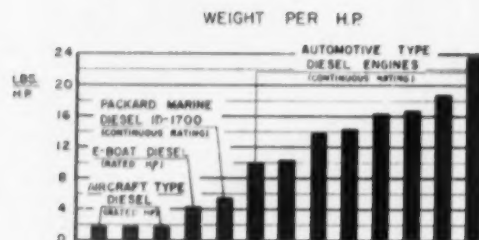


Figure 1.

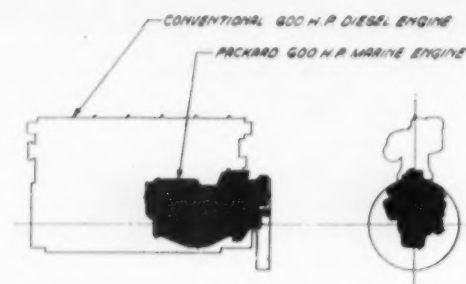


Figure 2.

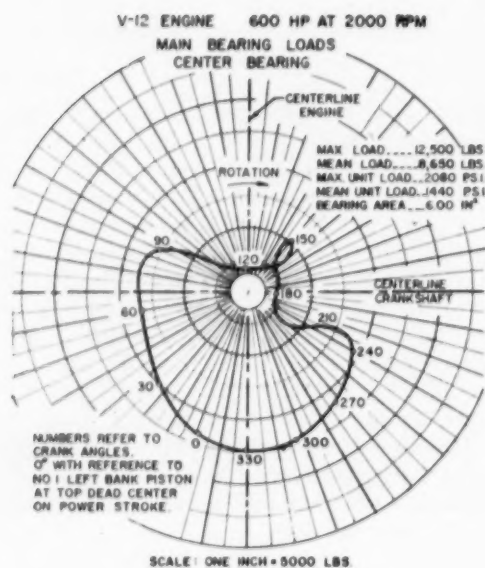


Figure 3.

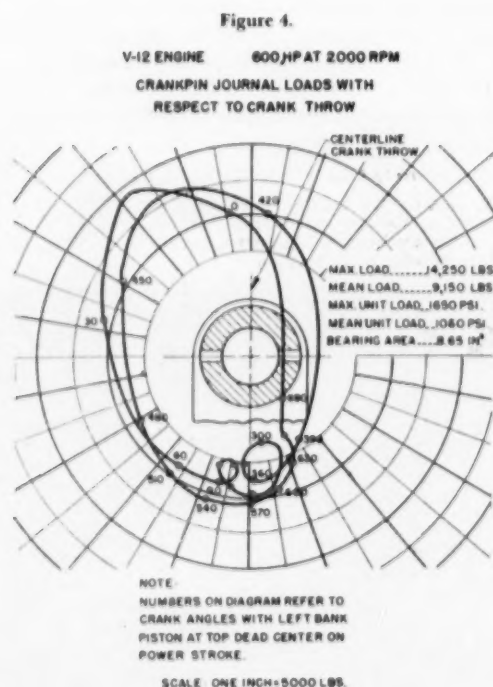


Figure 4.

THE new family of diesel engines developed by Packard provides reductions in weight and space occupied, while maintaining good life expectancy. Previous Packard experience in developing and building lightweight high output engines dates back to before World War I when Packard had a prominent part in the Liberty engine program. This was followed by a series of water-cooled aircraft engines which contributed to development progress after the war. Later on there was the pioneer experience with the lightweight diesel aircraft engine. Prior to and during World War II a series of high output liquid-cooled engines were developed for use in PT and air-sea rescue boats. While engaged in production of Merlin engines during the war, concurrent development programs resulted in 70% increase in the authorized rating of the engine.

As the development of the engine for the PT boats progressed, life was increased substantially not only for extended operation at emergency ratings but also for total hours at cruising ratings. These more recent experiences were of importance in the present diesel program in contributing definite guides for accomplishing the desired type of diesel engine with relatively long life potential. A family of four engine sizes was created—6, 8, 12, and 16-cylinder basic models—all four cycle. The 6-cylinder engine is an in-line engine, the others are 60° Vee engines. They have a large number of interchangeable parts and common features. The bore and stroke are the same for all engines.

There have been a number of lightweight diesels which are lighter than the new Packard engine. These are primarily aircraft types and include those construction features which are generally associated with aircraft engines. Aircraft engine ratings usually involve a take-off or emergency rating which is considerably in excess of authorized cruising ratings for extended operation. This type of rating is properly reflected in the type of engine structure. Weight per hp. for these engines and for representative automotive type diesel engines are shown in Fig. 1. For the automotive type engine, weights as related to continuous rated horsepower are shown, as obtained from Automotive Industries Statistical Issue. The Packard engines are intermediate in position as compared with the two.

Preliminary Development

A sample 6-cylinder engine constructed especially for combination with a high speed generator to provide a very lightweight combination unit was designed, built and tested. This engine demonstrated the practicability of the overall design features. Experimental sample cylinders were made at the same time and combustion chamber relations were investigated, to evolve a favorable combination. A single cylinder engine was used for this purpose. In proceeding from these experiences to the present engines, stress analyses and design investigations were based on higher horsepower ratings to be sure that the engines would have long life at the continuous ratings and also that there would be ample structures for higher ratings as future applications might require. Six-cylinder and 12-cylinder models were started almost simultaneously and the requirements also involved two different hydraulically operated reverse gears, one with a coaxial 3.2:1 reduction gear and the other with an offset 5:1 reduction gear. Generator sets with lightweight bases were also designed.

Engine Features

Noteworthy features of the engine include:

1. Extensive use of aluminum in order to obtain weight reduction.
2. A substantial crankshaft with considerable excess in bearing capacity for long service life.
3. Injection of fuel into a precombustion chamber for the purpose of eliminating high peak piston loading pressures.
4. Turbo-supercharger providing exhaust heat recovery.
5. Hard surface cylinders to reduce wear and minimize service replacements.
6. Nitrided crankshafts to provide maximum endurance strength and maximum journal and crankpin life.
7. Four valves per cylinder with stellite seating surfaces on valves and seats in the head.
8. Gear drives for all accessories with all gearing located at the flywheel end.

The general objectives are obtained by providing moderate supercharging for continuous operation

at moderate piston speeds. Rated power is obtained with 140 psi. BMEP and 2100 ft. per minute piston speed. The primary outside dimensions of the 12-cylinder, 1D-1700, 600-hp. engine are shown in Fig. 7. The relative space occupied as compared with a much heavier engine of the same rating, is considerably less. Fig. 2 shows a comparison with a slow speed type having the same output. This engine weighs more than 35,000 lbs. which is in excess of 10 times the weight of the 1D-1700 engine. Basic engine specifications are shown in Table I.

Construction Details

Fig. 6 is a longitudinal section of the 12-cylinder engine. Fig. 5 is a transverse section. The cylinder block and crankcase is an integral aluminum casting, made of 355 aluminum alloy with overaged heat treatment. This alloy and heat treatment provides a relatively high endurance limit. It is the main part of the overall engine structure and by virtue of the integral construction and design detail, provides rigidity which contributes considerably to the long life characteristics of the engine. A steel tube is cast into the crankcase forming the main lubricating oil gallery. The bearing caps are aluminum forgings. Long bolts extend from side to side of the crankcase and pass through all bearing caps completing an approach to a solid structure completely surrounding the main bearings. It may be of interest to note that this 12-cylinder block and crankcase casting weighs 550 lbs. after the machining operation.

Combining a substantial crankshaft with the rigid crankcase and good bearings is a major contribution to the long life objective. These three elements together form the backbone of the engine. The journals are 4 inches in diameter; the crankpins, $3\frac{3}{8}$ inches. The cheeks are 1 inch thick. Integral balance weights provide 58% balance. Crankpin bearing loading is shown in Fig. 4; loading on the center main bearing which is the maximum journal loading is shown in Fig. 3. These figures show that bearing capacity has not been sacrificed for light weight. The crankshaft is nitrided all over, and this not only provides outstandingly hard journal surfaces for wear resistance but also gives about the maximum possible fatigue strength using a commercial material.

The unit cylinder and head assembly is shown in Fig. 12. The inside diameter of the cylinder wall is nitrided in order to provide a hard wearing surface and thus extend the life of the cylinder and minimize servicing requirements.

The valve seating surface on both the cylinder heads and the valves are stellite to provide, again, long life between service operations. Inverted cup pearlitic malleable cam followers operate in cylindrical guides cast integrally with the valve guides. There are two camshafts for each cylinder bank. The cylinder and head assembly are formed by combining a 4130 precision cast cylinder head with a nitralloy barrel welded to a short extension formed on the head. Water spaces in the head are completed by two welded plates. All welds are done by machine, for a uniformly dependable structure.

Precision casting of the cylinder head contributes several important features.

1. Accurate control of cast dimensions permits reduced wall thicknesses.

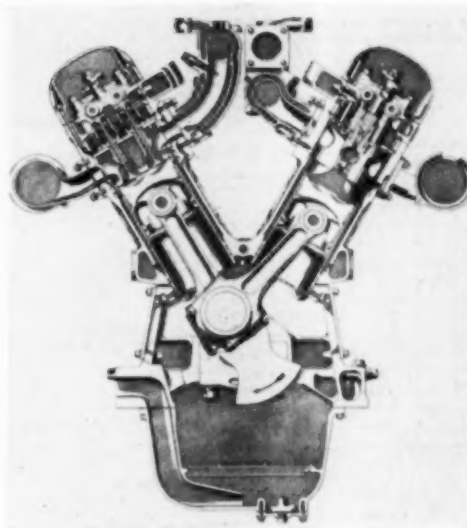


Figure 5.

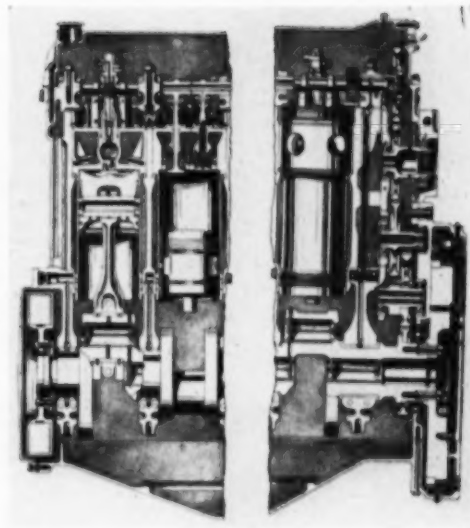


Figure 6.

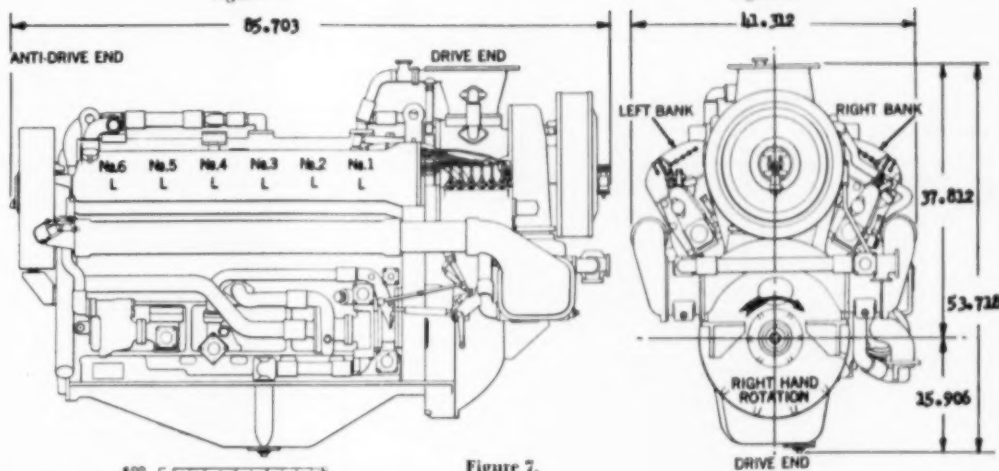


Figure 7.

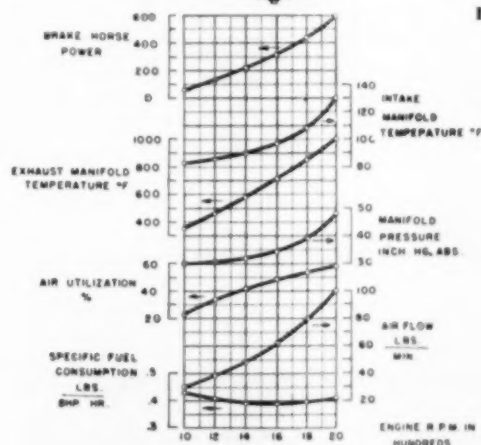


Figure 8.

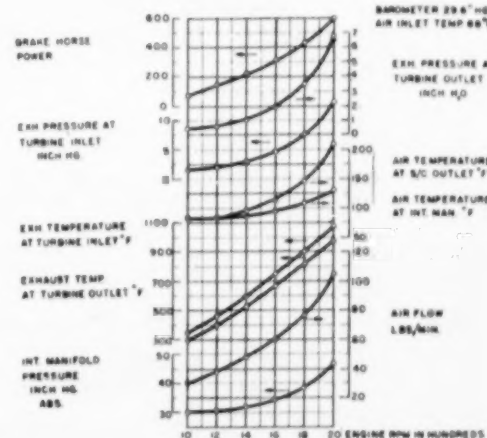


Figure 9.

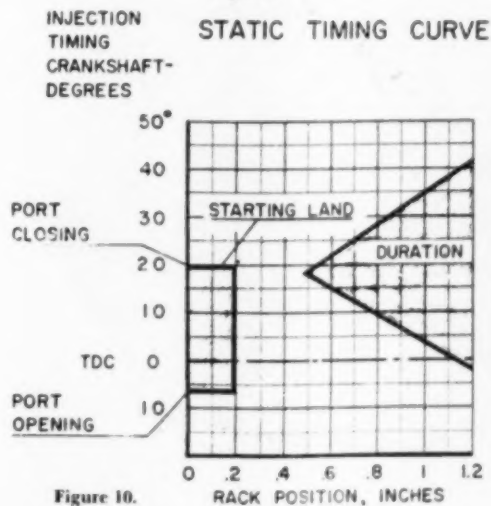


Figure 10.

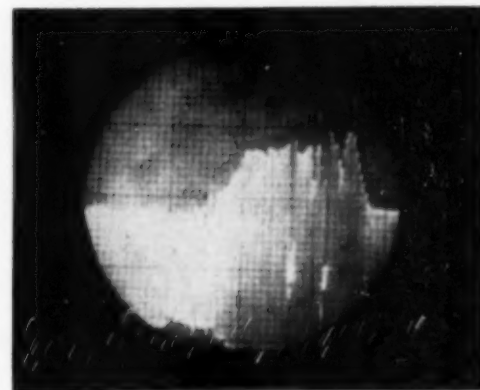


Figure 11.



Figure 12.

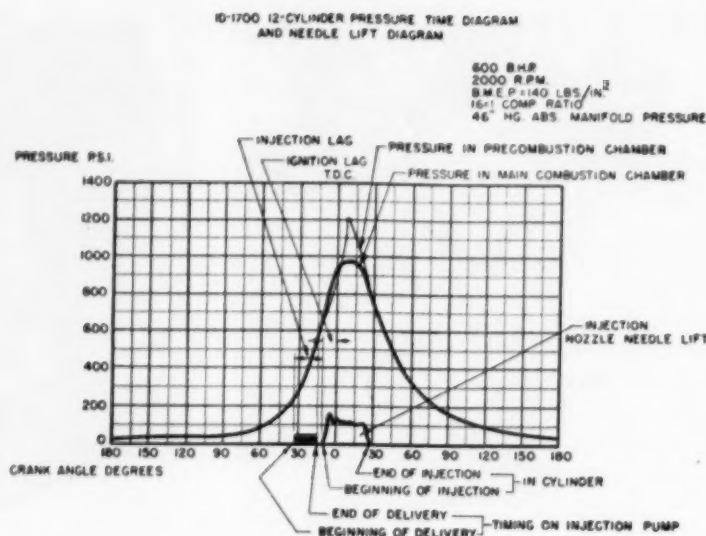


Figure 13.

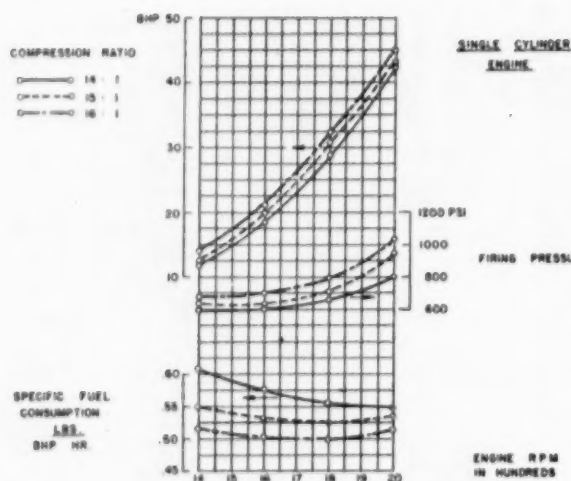


Figure 14.

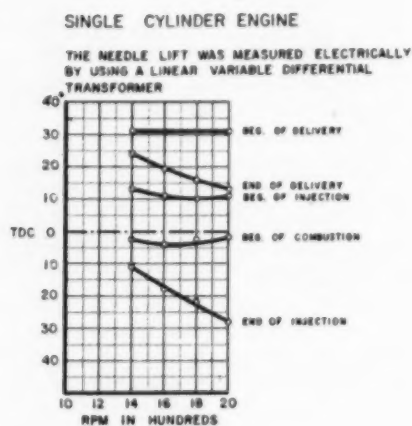
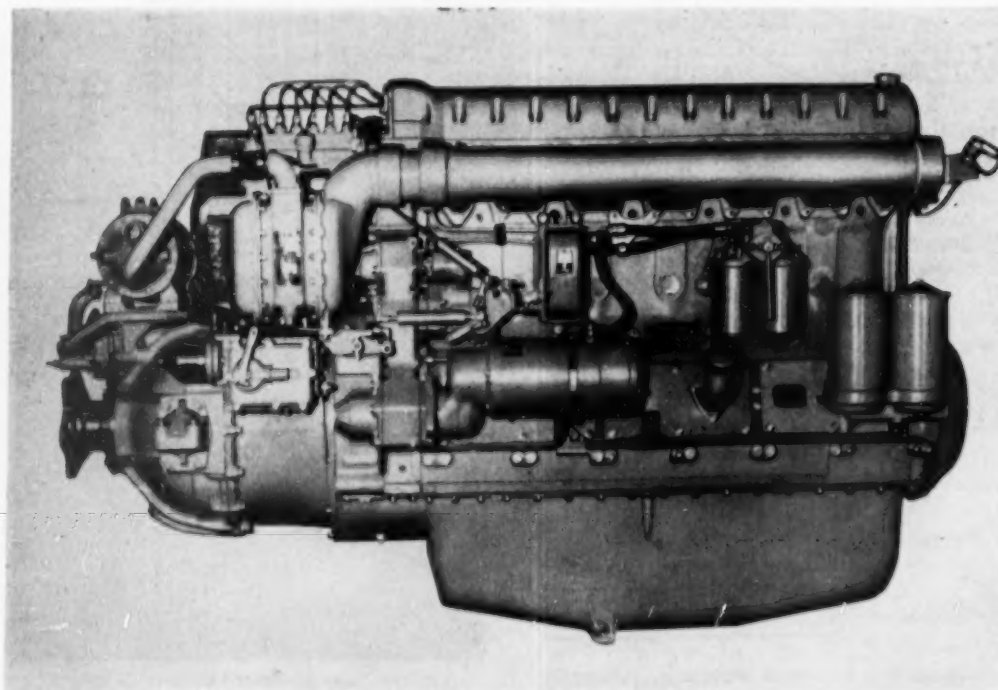


Figure 15.

Figure 16. Packard 6-cylinder 300 hp. engine combined with a 3.2:1 reverse and reduction gear. Harrison intercooler top left. Leece-Neville electric starter center. Both filters shown are Fram.



2. The surfaces of the port passages are relatively smooth in the cast form so that very little hand finishing is required.
3. The precombustion chamber does not require machining.
4. The precision casting method helps to provide a structure especially arranged to control the cooling water flow through the head.

The water enters the head through a series of holes located at the periphery of the cylinder head, and communicating with the jacket space around the barrel. A baffle within the head directs all the water substantially radially inward to the precombustion chamber location where the water rises to enter a space in the top of the head. In this way, all of the water is utilized in cooling the head, the precombustion chamber, and the injection nozzle. The fuel is injected directly into the precombustion chamber which communicates through a series of orifices with a toroidal space over the piston. This type of combustion chamber was chosen because of its ability to provide high mean effective pressures without high cylinder pressures and with moderate fuel line pressures. Both the low cylinder pressures and the low fuel pressures are long service attributes.

The piston is an aluminum forging. A total of five piston rings are used. The top ring is a chrome faced, rectangular section ring. The second and third rings are tapered faced compression rings. An oil ring located above the piston pin and one located at the bottom of the piston skirt are identical, and incorporate liberal slotted oil passages with tapered faced lands. The piston pins are full floating, and aluminum buttons are located at each end of the piston pin to provide a proper cylinder contacting surface.

All accessories are driven by gears located at the flywheel end of the engine. Most of these gears are mounted on antifriction bearings for reliability in operation and starting. With the drive from this end of the engine, gear life is extended and gear noise eliminated. Most accessories are separately removable and are located where they may be reached easily. Provisions are made for driving two 6-cylinder fuel pumps—one for each bank, two fresh water pumps—one for each bank, an oil pressure pump, an oil scavenging pump, an auxiliary oil pump for use with connected machinery, a governor, salt water pump, starting motor, tachometer generator, and an overspeed cutout actuating governor. The latter consists of a spring loaded rotating element which vents an oil line connected to the valve actuating plunger so that low oil pressure will be maintained in the connection during all operation. In case the engine speed is increased above the setting of the overspeed governor, the vent is closed off by movement of the spring rotor resulting in an immediate sharp rise in oil pressure at the far end of the connecting line, operating the plunger at that end to release a valve closing off the air supply to the engine.

The exhaust gases leaving the cylinder, enter a water-cooled exhaust manifold, continuing into the gas turbine side of the supercharger. The exhaust manifold and the supercharger turbine are water-jacketed in order to eliminate hot surfaces which are objectionable in marine applications both as a matter of comfort and safety. Insulated stainless

steel tubes are inserted in the exhaust manifolds to reduce the heat loss through the jackets and thus help turbine performance. The air leaving the supercharger is cooled by a heat exchanger, thus contributing to minimum fuel consumption.

Multi-Engine Performance

The continuous power rating of the 12-cylinder engine was established as 600 hp. at 2000 rpm.; slightly more than 300 is developed at 1200 rpm. The torque curve rises with speeds showing 1580 ft. lbs. at 2000 rpm. The specific fuel consumption is slightly over .4 lbs. BHP at 2000 rpm. These are without the benefit of correction factors. Since the original service applications of these engines involve marine propulsion uses, performance corresponding to an assumed propeller load is shown in Fig. 8. This also shows intake air temperature, exhaust gas temperature, intake manifold pressure, air flow, and air utilization. More detailed performance information on temperatures and pressures, air flow, etc., corresponding to supercharged engine operation are given in Fig. 9.

Injection System Performance

The fuel injection pumps are conventional American Bosch units, excepting the main housings are made of aluminum, and the plungers have special features related to fuel timing control. The nozzle is of conventional pintle design. The pump plungers are 10 mm. diameter; the pintles in the nozzles are 2.0 mm. diameter. The pump plungers have helices for both the start and finish of injection, as shown by the pump diagram in Fig. 10. These have been specified to provide timing more suitable than could be obtained with a single helix. This feature has helped to compensate for the omission of a variable timing device.

A land is formed in the working zone of the plunger occupying the first .2 in. of rack travel, to provide a fixed port opening and port closing for this portion of the rack. This results in a special timing and quantity of fuel particularly favorable for starting. This land extends over a sufficient portion of the rack travel to permit the special starting setting to be obtained without precise positioning of the rack. One application of the engines required positive starting in minimum time and this starting land was a useful aid in meeting this objective. Fig. 19 shows the prompt starting that is obtained and rapid acceleration at normal room temperatures.

The rack is ordinarily connected to a hydraulic governor. A control arrangement is provided by means of which the governor connection is modified to establish the starting land position of the rack while starting. The control is then moved beyond the run position to give sufficient rack movement until the governor becomes operative. In the run position the governor has full control. Zero fuel delivery, as required for stopping, is obtained by moving the rack to a position between the starting land and double helix portions. The relation between beginning and end of pump action, and the beginning and end of injection into the cylinder and the start of actual combustion is shown in Fig. 15. It applies to propeller load operation over speed range and 12 mm. lower helix plunger.

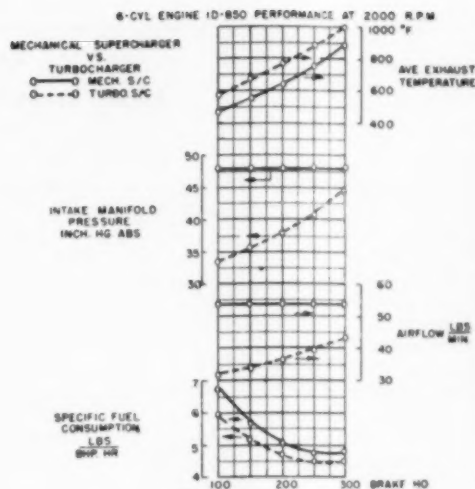


Figure 17.

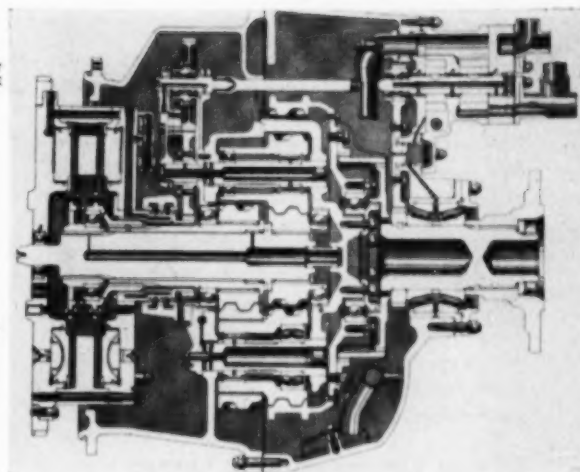


Figure 18.

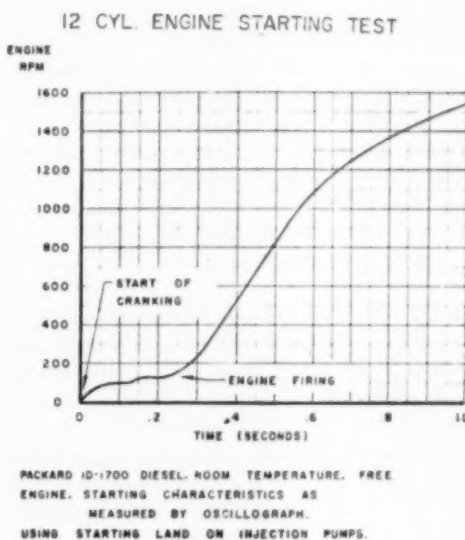


Figure 19.

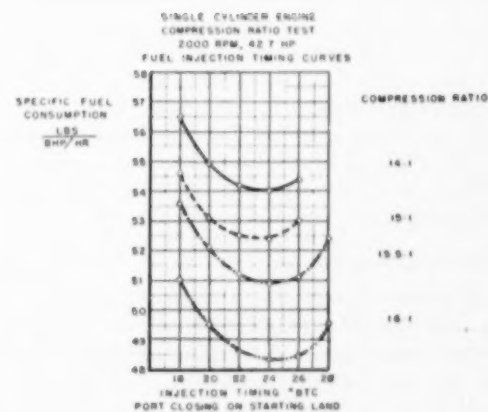
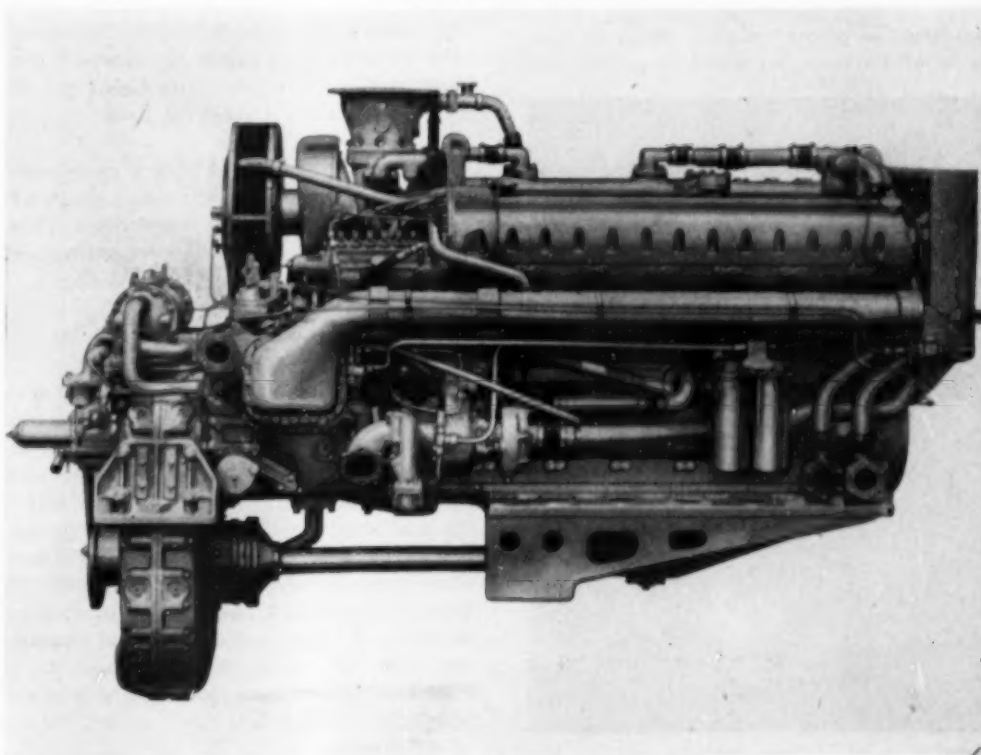


Figure 20.

Figure 21. The 12-cylinder Packard diesel engine modified by the adaptation of a 5:1 reverse and reduction gear.



The beginning and end of injection were determined with electronic equipment utilizing a linear variable differential transformer providing a variation in output, dependent on the position of a small armature fastened to the needle of the injector. The type of record produced by this equipment is shown in Fig. 11. Fig. 13 shows the relation between the injection pump action, the injection nozzle needle lift and the pressures developed in the cylinder at rated load in speed. Measurements were also made of the pressure in the precombustion chamber. These diagrams indicate that pump action has been completed before the needle lift begins. The diagrams indicate rather rapid lift of the needle with greater displacement at the start than the end.

Effect of Compression Ratio Changes

Single cylinder tests were made with four different compression ratios: 14, 15, 15.5, and 16:1. Data showing brake horsepower, maximum pressures and specific fuel consumption as a function of the engine rpm. for the four compression ratios are shown in Fig. 14. These tests show conventional effects. It is of interest to note that there is less variation in the specific fuel consumption over the speed range at the highest compression ratio. These tests were made with a constant fuel supply. The curves in Fig. 20, showing the result of varying injection timing indicate no important change in sensitivity of timing due to changes in compression ratio.

Supercharging

The effects of varying supercharger pressure were also investigated on the single cylinder engine. Data obtained at 14:1 compression ratio and with variations in absolute intake manifold pressure from 50 in. of mercury to 70 in. show that the compression pressure as estimated varies in direct proportion to the absolute manifold pressure while the maximum, or firing pressure, increases at a slower rate. This situation is useful in applying the cylinder for higher output. Substantial increases in power can be obtained without encountering extremely high pressures.

The favorable pressure relations shown by these curves are further substantiated by pressure-time



Figure 22.

Model
Continuous Rating
Bore and Stroke
Piston Displacement
Compression Ratio
Valve Arrangement
Combustion System
Crankshaft
Lubrication System
Starting
Fuel System
Cooling System Pump
Supercharger
Basic Engine Weight

TABLE I
BASIC ENGINE SPECIFICATIONS

6-Cylinder	12-Cylinder
2D-850	1D-1700
300 HP at 2000 RPM	600 HP at 2000 RPM
5 3/8 x 6 1/4	5 3/8 x 6 1/4
852 cu. in.	1704 cu. in.
15 to 1	15 to 1
Overhead (4 per cylinder)	
Precombustion Chamber	
Steel Forging—surface hardened	
Dry Sump	
Compressed air or electric motor	
Multi-plunger pump with pressure operated injection nozzles.	
100 gal. per min.	200 gal. per min.
Exhaust gas turbine driven centrifugal compressor.	
2195 pounds	3300 pounds

diagrams taken with an oscilloscopic indicator. Oscilloscopic records are shown in Fig. 22. These were taken at a constant absolute manifold pressure of 65 in. of mercury and were obtained primarily to determine the effect of changes in injection timing. The curve with 12° port opening approaches the ideal diesel diagram. As the timing is advanced to 18°, the pressure rise becomes faster and the amount of rise greater. The diagrams are obviously quite favorable for extended service life as compared with the distinctly sharp rise that is obtained with many direct injection engines.

The present multi-cylinder engines have a continuous rating of 50 hp. per cylinder. It is noted that this same cylinder in these single cylinder tests shows over 85 bhp. at 70 in. of mercury. The friction relations of the single and multi-cylinder engines are such that still greater hp. per cylinder would be developed under the same conditions on the multi-cylinder engine. The first multi-cylinder engine of this type to be built was equipped with a mechanical supercharger and in preparing for the present series of engines comparative tests were made with a mechanically centrifugal supercharger and a turbo-supercharger. Some results of these tests are shown in Fig. 17. At the 300 hp. continuous rating of the 6-cylinder engine: (1) the exhaust temperature with a turbo-supercharger is 100° higher with the turbo-supercharger, and (2) the specific consumption is about 5% lower.

It will be noted that the air flow is considerably less with the turbocharger which may count partially for the higher exhaust temperatures. These results were obtained with 90° valve overlap and normal exhaust opening and intake closing.

Non-Magnetic Constructions

A special and unusual requirement, experienced in some applications, involved high non-magnetic content. These engines as basically designed were attractive for this purpose, since aluminum was used in considerable quantity where cast iron or steel is the more usual material. The non-magnetic content was increased by using bronze in place of steel where aluminum was not adequate. Further increases in non-magnetic content were accomplished by the use of nitrided stainless steel and non-magnetic nickel alloys in highly stressed parts such as crankshafts and connecting rods. In this way, the non-magnetic content was raised to 80% in one of the engines.

Since there was no suitable information on the fatigue characteristics of nitrided stainless steel, a series of fatigue tests were made. These tests employed an unusual test specimen form, including a notch effect more nearly representative of engine parts than the standard specimen. The notch tends to lower values. Some values of interest are:

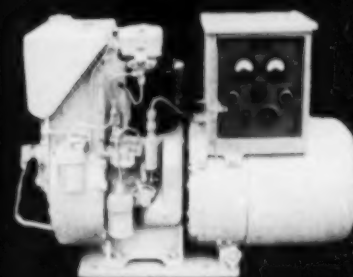
X4340—302 Brinnell	28,000
VCM—Rockwell C-30	32,000
VCM—Nitrided	67,500
347 Stainless	22,000
347 Stainless—Nitrided	38,500

As in other tests, nitriding raises the endurance limit considerably. While the endurance limit of the nitrided stainless is less than nitrided VCM, it is still greater than a 40 carbon, strong alloy steel.

Applications

In concluding this presentation, a series of illustrations will show some applications of the engine to date. Fig. 16 shows the 6-cylinder 300 hp. engine combined with a 3.2:1 reverse and reduction gear. Fig. 18 is a sectional view of the reverse gear. The output shaft is coaxial with the crankshaft. The forward and reverse clutches are hydraulically operated and the oil supply required for this purpose and for lubrication of the gear is separated from the engine oil in order to avoid contamination by any dirt-making conditions that may arise in the engine. No separate reversing gears are provided. Each clutch has a separate sun gear which meshes with a single ring gear through two plant systems, one for each direction of rotation.

Fig. 21 shows the 12-cylinder engine modified by the adaptation of a 5:1 reverse and reduction gear. This reverse gear is also hydraulically operated. In this case, the output shaft is offset from the crankshaft. This gear embodies several unique features. Of special interest is the arrangement for transmitting the propeller thrust through the reduction gear housing to a thrust bearing located on the forward side of the housing. The thrust bearing is mounted in a carrier which is guided by the housing but permits the carrier to move longitudinally with relation to the housing. The carrier is restrained by a strut which connects to the engine mounting structure, thus relieving the entire engine structure of thrust loads. The "bull gear" is mounted on separate bearings arranged to take the main gear reactions, and driving torque to the shaft is transmitted by a thin web. This is particularly favorable for light-weight construction.



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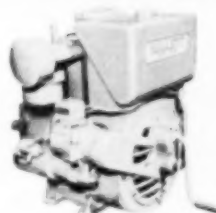
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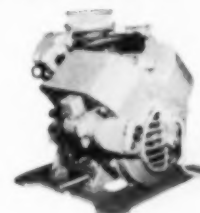


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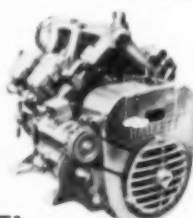


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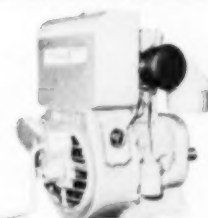


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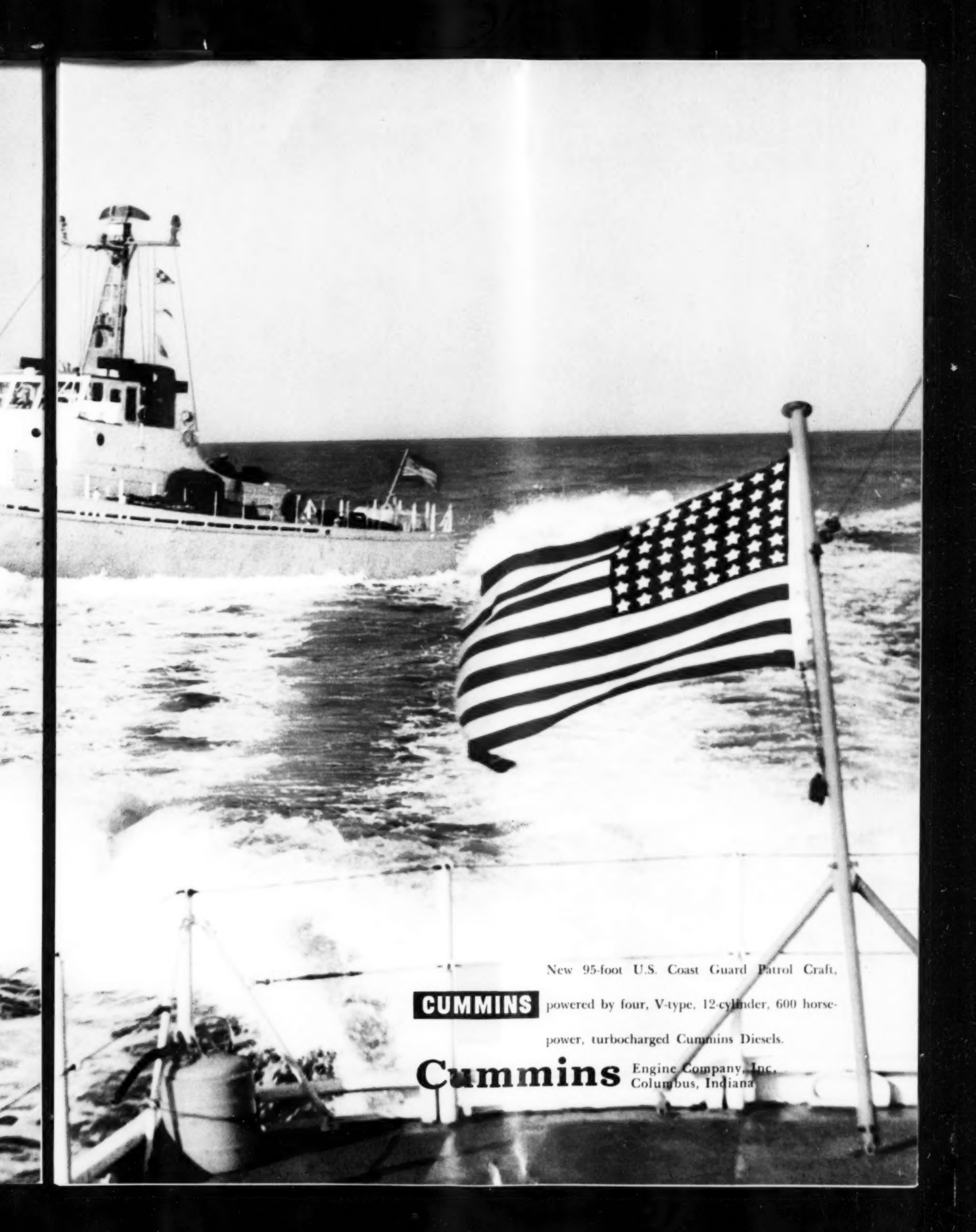


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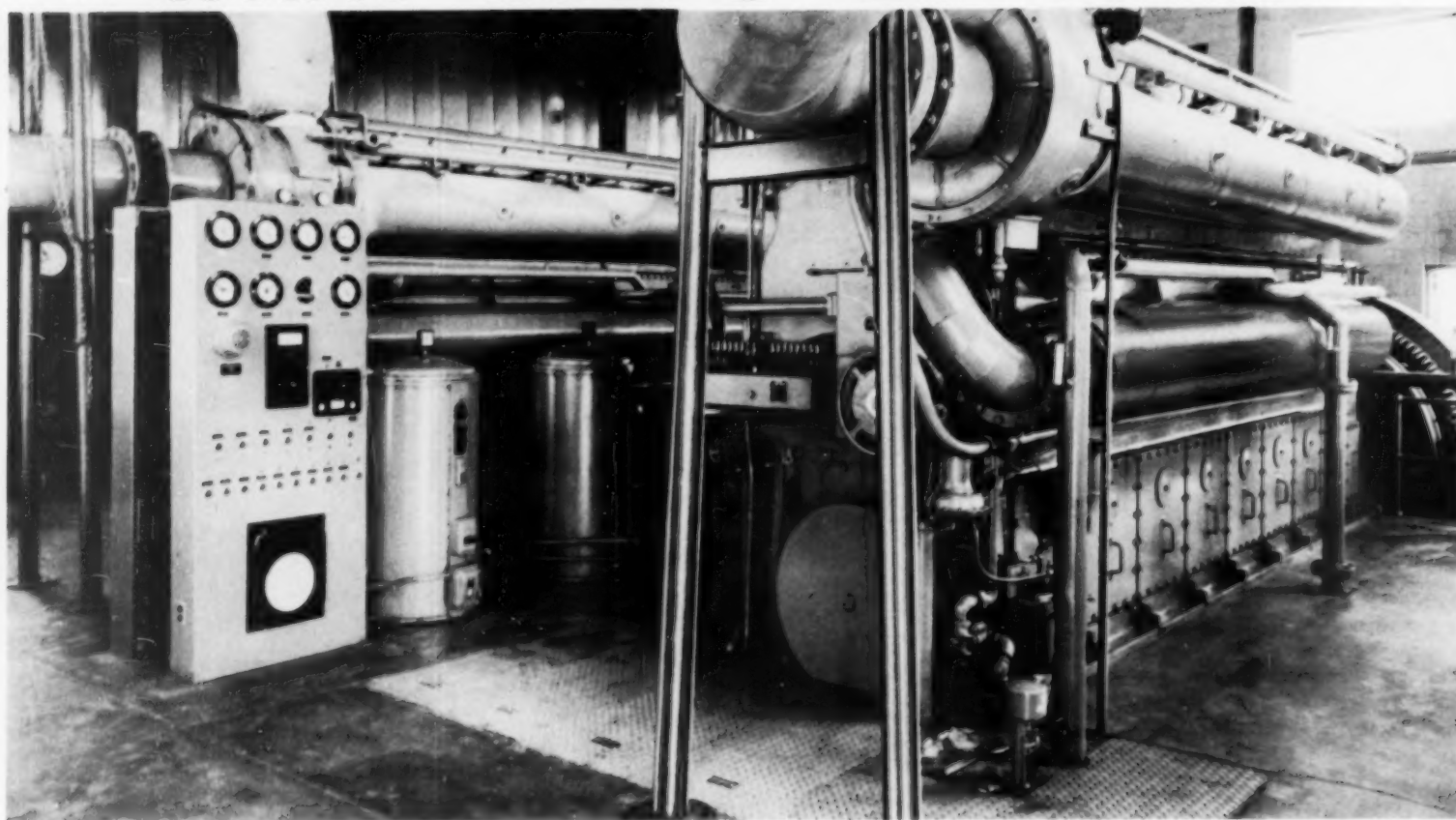
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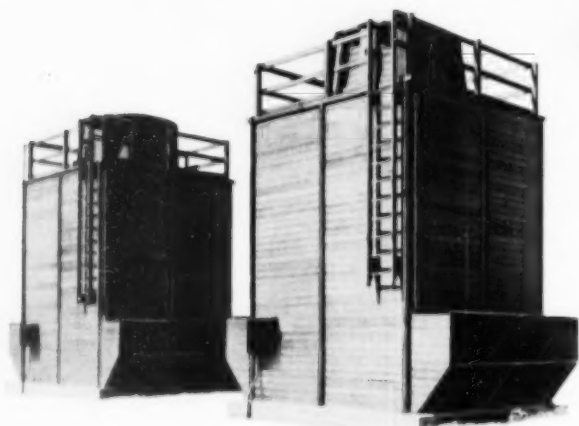
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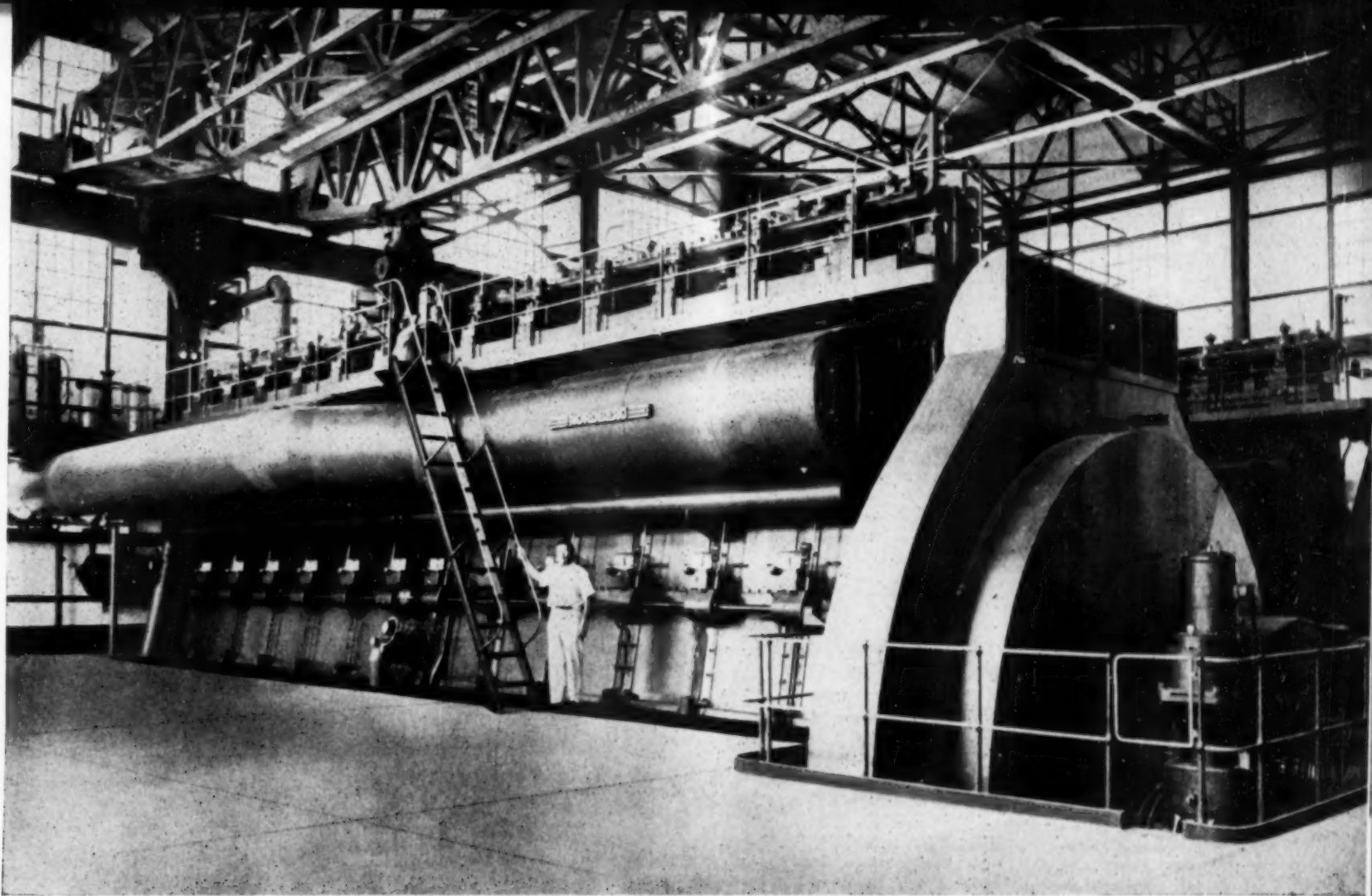
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DIESEL PROGRESS



One of the two Nordberg 2-cycle, 29-in. bore, 12-cylinder diesel engines rated 8,950 bhp., 171 rpm. at 4,166-ft. elevation of Coya Sur power plant. Engines drive 7,000 kw. General Electric generators.

COYA SUR DIESEL GENERATING PLANT

By JAMES COMPTON*

GIVEN the "go-ahead," engineers and diesel plant operators of the Anglo-Lautaro Nitrate Corporation near Tocopilla, Chile, in collaboration with the Nordberg Manufacturing Co. have concentrated many new operating ideas into one unique installation. The recently completed two-engine plant forms part of a three-plant network, all within a radius of 10 miles, whose combined power generating facilities amount to an impressive capacity of 46,000 kw. The new plant was designed and built by the engineering and construction departments of the Anglo-Lautaro Nitrate Corporation. The operations of this company cover a large area in the nitrate fields inland from Tocopilla and Antofagasta with two equally large nitrate producing plants located at María Elena and Pedro de Valdivia. In addition to the plants engaged in the production of nitrate, the

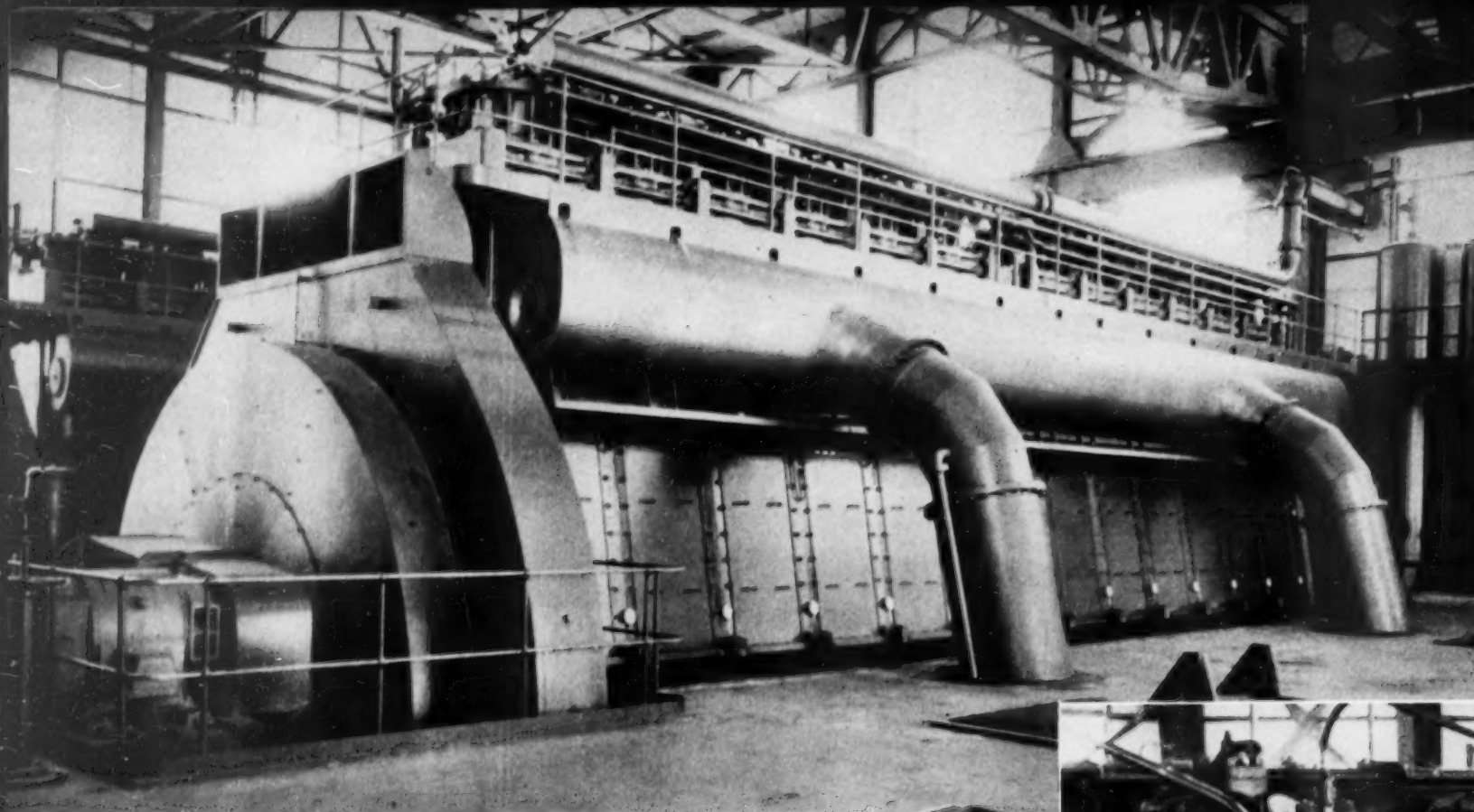
*Mr. Compton is mechanical engineer at the new Coya Sur power plant.

company owns and operates a 100-mile, partially electrified railway between the plants and the port works at Tocopilla.

Early in 1951 the operations of these plants were in a difficult power situation. Due to the completion of the solar evaporation plant at Coya Sur and electrification of the railway from María Elena to a new mining area, the plants were forced to operate without any reserve power. Under these circumstances it was impossible to expand or to further electrify the ore haulage system. It was necessary therefore to install additional power in order to go ahead with plans for expansion of production facilities. Having decided to install the additional power capacity, there was considerable discussion as to the advantages of locating the new plant in Coya Sur instead of extending the existing power plants of María Elena or Pedro de Valdivia.

The María Elena plant could not be extended simply because there is no room for additional engines. There is ample space for extension to the power plant in Pedro de Valdivia, but there also it would have been necessary to install all new auxiliary equipment, thereby reducing any economic advantages to a relatively small amount. Furthermore, at Pedro de Valdivia no use could be made of the waste heat from additional engines. The most important reason for finally deciding upon the Coya Sur location is that this area is now and probably will continue to be, for the life of these properties, the center of the load for the entire electrical system. The construction of a new plant in this area would result in economies from the standpoint of line losses as well as facilitate the distribution of power in the most efficient manner.

Because it is also possible that the installations of the solar evaporation plant might be extended



Another view of one of the Nordberg 2-cycle, 12-cylinder diesels in the Coya Sur generating plant.

in the near future and that other by-product plants will be constructed in this same area, it is convenient to have not only a nearby power source, but also waste heat that can be used in the form of hot water or steam. The hot water and steam can be used in the proposed by-products plants and also are of immediate use to heat the solutions of the now existing evaporating ponds to increase the rate and amount of evaporation. Having decided upon the amount of additional power required and the site of the proposed new power plant, the Nordberg Manufacturing Co. was consulted for suggestions concerning the layout of the new plant.

Engineers of the Anglo-Lautaro Nitrate Corporation had in mind two engines of the type installed by Nordberg for the Mexican Power and Light Co. at Tacubaya, Mexico. The units supplied for the Tacubaya plant were rated at 8,650 bhp. at sea level and 167 rpm. for driving 50-cycle generators. Since the completion of the Tacubaya plant in 1949, the Nordberg Manufacturing Co. has redesigned the combustion space with a resulting improvement in fuel rates and ability to develop 70 bmep. with clear exhaust on continuous rates; this type of engine, now installed at Coya Sur, is rated at 9,600 bhp. at sea level, corresponding to 8,950 bhp. at 4,166 feet elevation (elevation at Coya Sur) operating at 171 rpm. The usual margin of 10% overload for 2 hours in any 24-hour period has been retained. This extra boost in power for the same size unit was very appealing to the company's engineers and these engines were selected to be the most desirable.

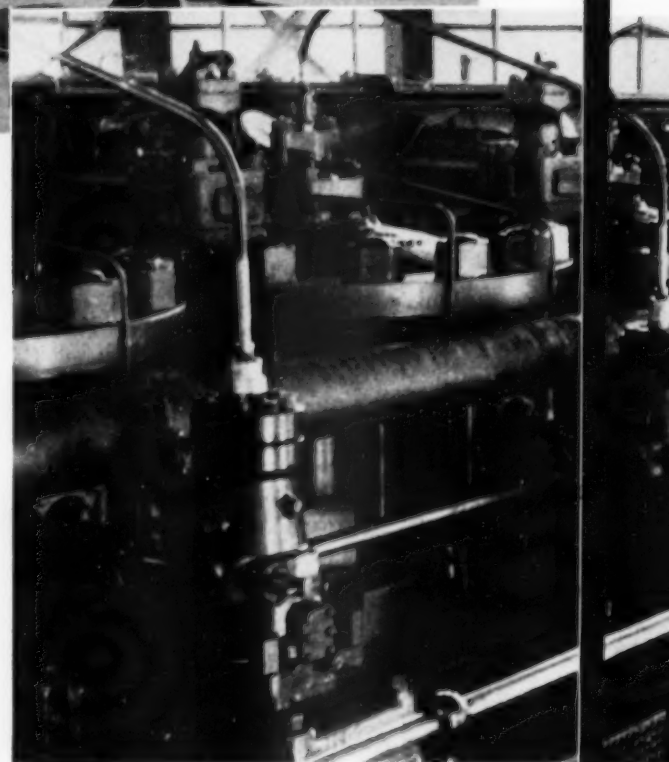
The engines are vertical, 2-cycle, crosshead type with mechanical injection. Each has 12 cylinders in-line of 29-in. diameter and a 40-in. stroke. The

brake horsepower of 8,950 and electrical rating of 6,400 kw. at 80% P. F., mentioned above, are net capacities after deducting the power required to drive the motor-driven scavenging blower. The power input to the motor driving the blower is about 545 kw. when the engine is operating at full load. The generators, furnished by the General Electric Co., are of the flywheel type, totally enclosed, for forced air ventilation and are rated at 8,750 kva., 7,000 kw. at 80% P. F. The totally enclosed feature of the generator will tend to eliminate the deposits on the winding, of the oily mist coming from the oil fumes and provides more efficient cooling of the generator.

Each of the Nordberg diesel engines is equipped with a 6-in. Fulton Sylphon regulator for the cooling water temperature control and a 4-in. regulator for lube oil temperature control. The fuel oil system is equipped with two 2-in. Fulton Sylphon temperature regulators to heat the fuel prior to its going through the centrifuges.

The steel structures to house these engines and their auxiliaries were designed and detailed in the company's own engineering offices. The completed drawings were sent to the Bethlehem Steel Corp. where the structural steel for the buildings was fabricated. Ground was broken for the foundations on the nearest rock out-crop to the solar evaporation plant. This happened to be the site of an old nitrate plant which, very conveniently, has the added advantage of already constructed terraces that were later used to place jacket water tanks and other storage tanks at the proper elevation without costly masonry work.

The main engine room is extra large, 84 feet wide by 108 feet long, to insure cleanliness and to pro-



vide room for safe handling of large pieces around the engines. Along the east wall of the engine room a gallery at engine operating platform level provides space for walkway between engines and the fuel oil heating and filtering units. The starting air bottles are also along the east wall on concrete pads with their head ends passing through openings in the gallery floor. Concrete foundations for the engines were poured to a height a few feet below engine room floor level

so as to have the top of the engine bedplates flush with the floor. The bedplates, which are in two halves, are not grouted and bolted directly to the foundations in the usual manner; instead, they rest on shims which, in turn, rest on machined surfaces of special box type, cast iron girders concreted into the foundations and running the full length of the engines. These girders have eight

cast-in chocks on each side of the engines to wedge-in the bedplates against any horizontal side movements. This construction is necessary because of frequent seismic movements which cause misalignment of the bedplate sections.

Cool air for the engine room is supplied through grilled openings in the floor. This air is discharged from the building through louvered vents in the monitor which runs the full length of the roof, thus providing movement of the air to remove vapors from the engine room. A track entrance has been provided on engine room floor level by means of an approach trestle. This entrance is used for supplies and heavy pieces of machinery which must be transported by rail. When not in use a large rolling door is pulled down to close off the opening against heat and dust.

The pride of this new plant is the control room. A full-width glass partition separates the control room lean-to from the main engine room. Here the operator sits in air-conditioned comfort be-

ture for each cylinder with a transfer switch is mounted on the control panel along with an engine alarm system to indicate by howler and lamps excessive temperature and/or low pressure of engine jacket water and lubricating oil. All of the electrical switch gear and controls were furnished by the General Electric Co. with the exception of the special control panels which were furnished by the Nordberg Manufacturing Co.

On the same floor and adjoining the control room and engine room is the air washer lean-to. The air washers and air washer blower fans are duplicated for emergency use in case of failure and to facilitate maintenance. The air washers are mounted one above the other on different floors and two are required for each fan. The air washers are of the centrifugal spray type with louvered intake to the outside of the building and eliminators on the fan side. The four air washers were furnished by the American Blower Corp., and have a capacity of 75,000 cfm. of air at 70°F. each. Each 152,500 cfm. heavy duty fan, also furnished by

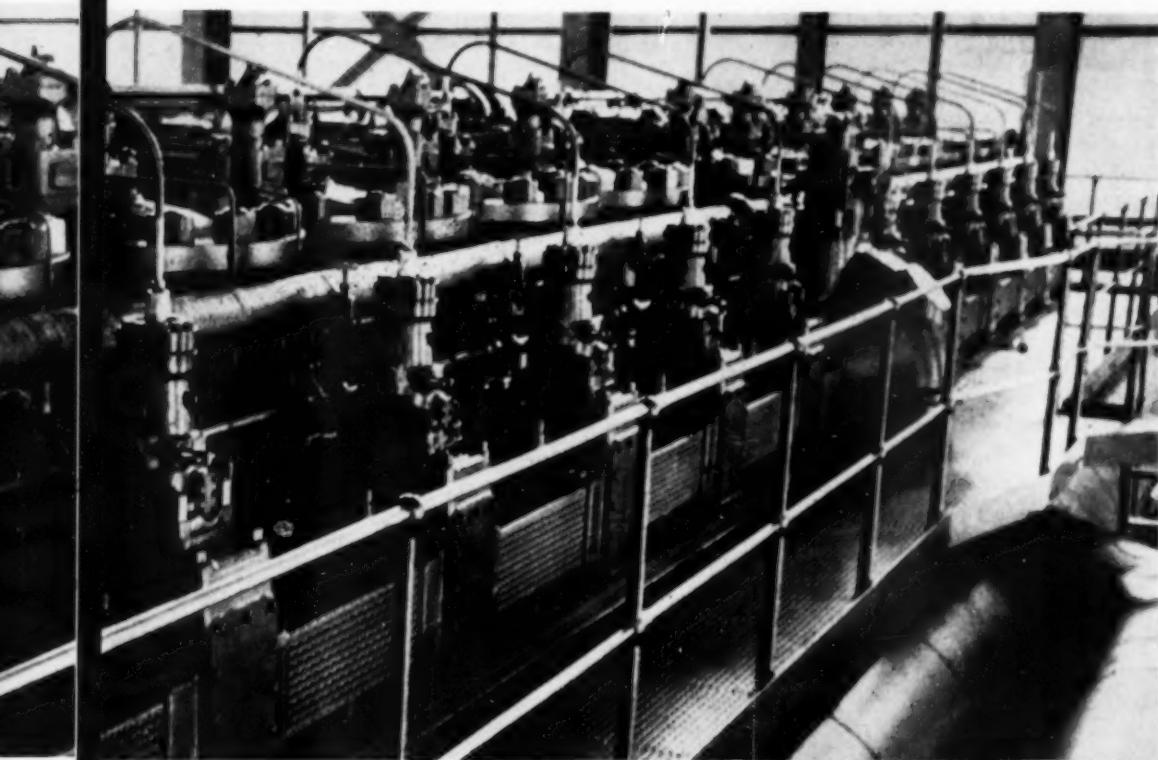
the American Blower Corp., is equipped with shutter on the discharge side so that either fan may operate while the other is not in use. The air from these fans provides ventilation for the generators through the plenum chamber and serves as the intake air for the scavenging blower. These fans also supply ventilation to the main engine room, auxiliary equipment room and control room by way of ducts connecting to the plenum chamber.

Two different grades of fuel oil are used for this installation, and their physical characteristics are listed in the table below.

	<i>Talara</i>	<i>Stanship</i>
Specific gravity at 60°F.	.890	.916
Beaume 60°F. A.P.I.	27.5	23
Viscosity SSU at 122°F.	76	60
Flash Point	180°F.	150°F.
Fire Point	240°F.	—
Carbon Residue (Conradson)	2.01%	.1%
Ash	.03%	.02%
Sulphur	.23%	1.25%
Asphalt soft	.42%	—
Asphalt hard	.16%	—

A considerable amount of foreign material is found in the fuel principally because it is transported from the seaport to the plant in a fleet of tank cars which also transport Bunker C. Although the fuel oil is heated and centrifuged, sufficient foreign material passes through to make additional filtering necessary before the fuel enters the engine in order to minimize wear on the fuel pumps and injection valves. A 5,000-ton capacity all welded fuel oil storage tank receives the incoming fuel from tank cars. From the storage tank the fuel is drawn off as required through a steam heater, adjacent to the tank, by pumps. The heated fuel is then pumped through a Cuno Auto-Klean edge type filter and then into another steam heater which is thermostatically controlled to maintain a constant temperature for centrifuging.

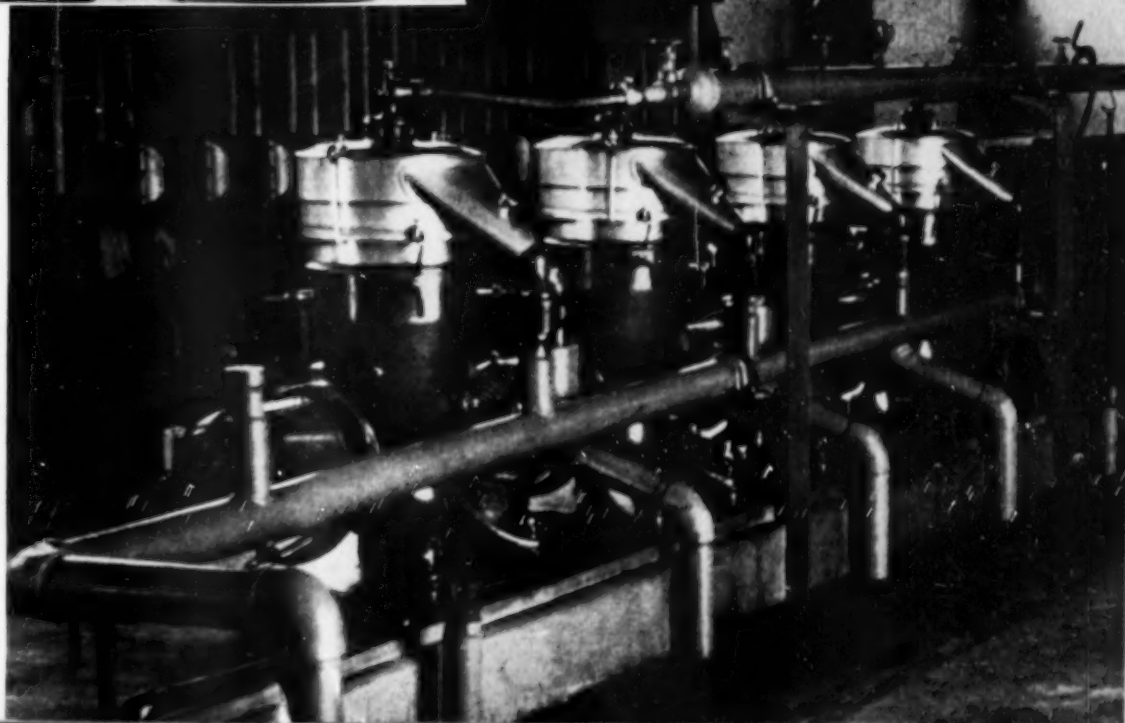
Oil cleaning room at Coya Sur plant showing DeLaval centrifuges.

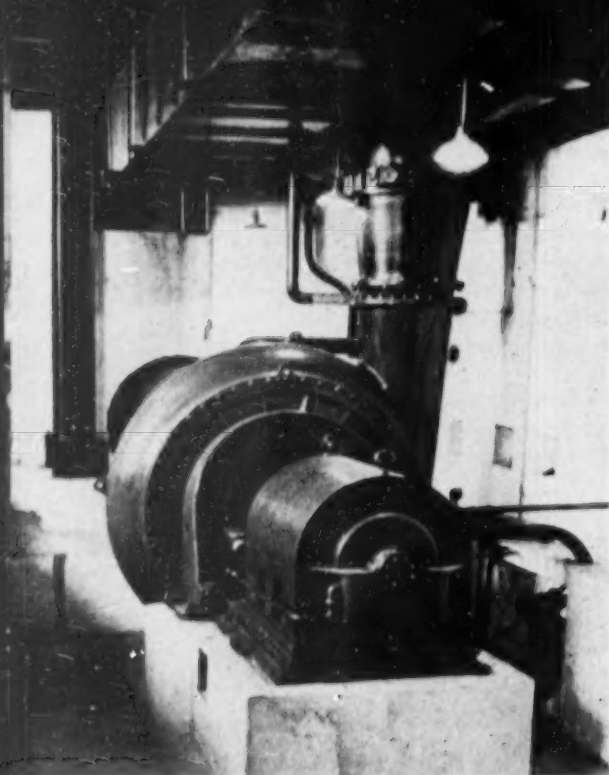


Operating platform of one of the two 8,950-hhp. Nordberg diesels at Coya Sur showing Bosch fuel pumps and Woodward governor.

hind a control desk on which are mounted warning lights and auxiliary equipment push-button switches. In addition to the standard control room equipment found in modern diesel plants, special gauge boards and control panels have been installed for each engine on which are mounted all engine gauges, remote controls for starting, loading and stopping the engine and blower motor control and push-button stations for all auxiliaries. A special resistance thermometer with 28 points to indicate temperatures of lubricating oil and jacket water to and from the engine has been provided for the diesels.

An exhaust pyrometer for indicating the tempera-





Elliott scavenging air blower and motor are mounted on one piece cast iron base plate in the plant's lower level.

Six DeLaval centrifuges are installed in two groups with two in the first group and four in the other. The units in the first group are used as separators, and are installed upon a platform above the level of the second group which are used as clarifiers. The difference in levels makes it possible to feed the clarifiers by gravity from the discharge of the separators. The discharge from the clarifiers also flows by gravity into a sump tank. The sump tank is equipped with levels controls to automatically actuate the pumps which deliver the cleaned fuel oil to the service tanks located on a terrace outside of the main engine room. Although the static head provided by the elevated service tanks amounts to about 20 psi, booster pumps were installed between the service tanks and the Nugent filters to increase the pressure to

30 psi. to insure adequate circulation when using the heavier of the two fuels mentioned above.

Chromolox electric heaters were also installed for service when using the heavier fuel to raise the fuel temperature from 10°C. to 50°C. before going into the Bosch fuel pumps on the engine.

The Nugent filters, Chromolox heaters and fuel oil booster pumps are located on the operating gallery behind the engines. All piping between these units is of copper tubing with high melting point soldered joints.

Manzel force feed lubricators with seven separate pumps and feeds for each cylinder supply lubricating oil to the cylinder liners of the engines. The reservoirs of these lubricators are normally filled by an attendant while making routine inspections of the lubricators and other parts of the engine. Since this power plant is designed to operate with only the switchboard operator and an assistant, a system for maintaining a constant level in the reservoirs of the lubricators has been developed, allowing the assistant switchboard operator to make only one trip per shift around the lubricators to see that they are functioning properly. By eliminating the human element from the important task of filling the lubricator reservoir, lubrication of the cylinders is more dependable.

For this system a lube oil storage tank was placed in the basement with remote level indication on the control desk. From this tank lube oil is pumped in a closed circuit to a small tank mounted on the wall behind each engine. The level in the wall mounted tank is on level with that of the lubricator reservoirs. A header connecting all lubricators on one engine with the constant level tank passes beneath the floor and has risers to each lubricator.

In each of the risers is placed a short section of Neoprene rubber hose which can be pinched shut for testing oil consumption and distribution of

lubricators. Rubber hose was selected instead of valves because of the possibility of leaving a valve closed. The rubber hose system employs one pinch clamp which must be returned to the switchboard after an operator has tested the lubricators.

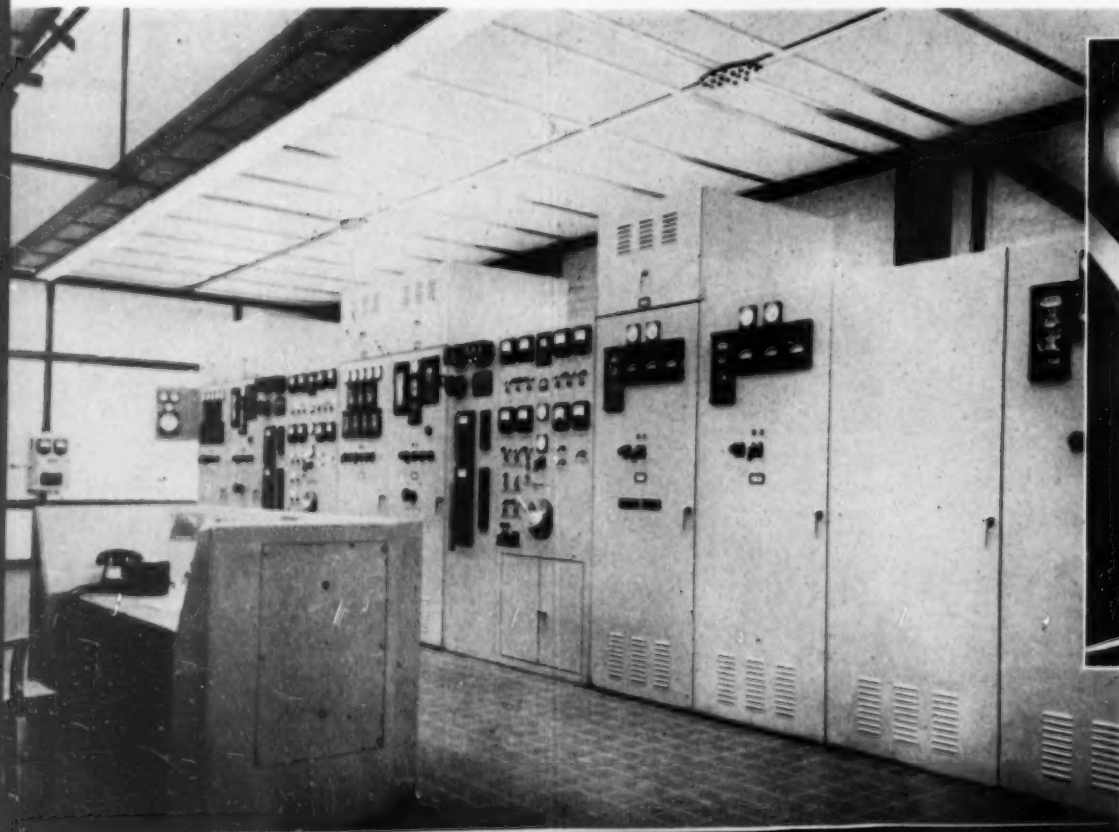
Crankcase lubrication for each engine is accomplished by vertical pumps with built-in check valves mounted in a closed sump tank that is divided into high and low pressure compartments with an internal strainer. This arrangement eliminates the large and complicating piping, leaky glands, check valves and external strainer. Three pumps were installed in a 3,000-gallon sump tank, any two of which can supply the required quantity, the other being a spare. Pressure and selector switches permit the operation of any two pumps; if either of them fails to maintain the required pressure, the idle pump is automatically started.

The discharge piping from the high pressure compartment of the sump tank runs directly to the lube oil coolers and then returns to the engine inlet. The sump tank is also provided with a recirculating system to Honan-Crane Purifiers which keep the lubricating oil clean.

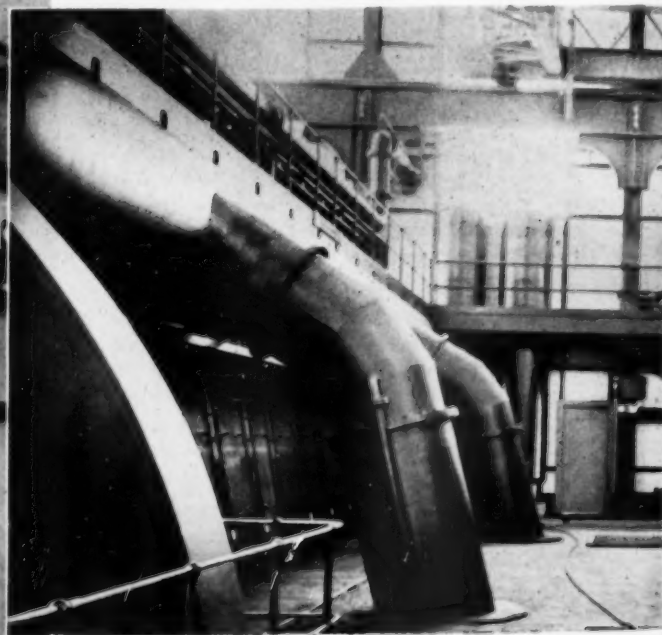
Next in importance to the power generated by this installation is the use of the waste heat from the engines. As was mentioned earlier, one of the primary reasons for building the power plant near the solar evaporation plant in Coya Sur was to take full advantage of the waste heat. The heat rejected to the jacket water and in the exhaust gases is the source of heat used to concentrate solutions and to distill river water used as make-up water for the cooling system of the engines. The heat reclaimed from the jacket water is over twice as much as that reclaimed from the exhaust gases and, therefore, more important from the standpoint of recovery.

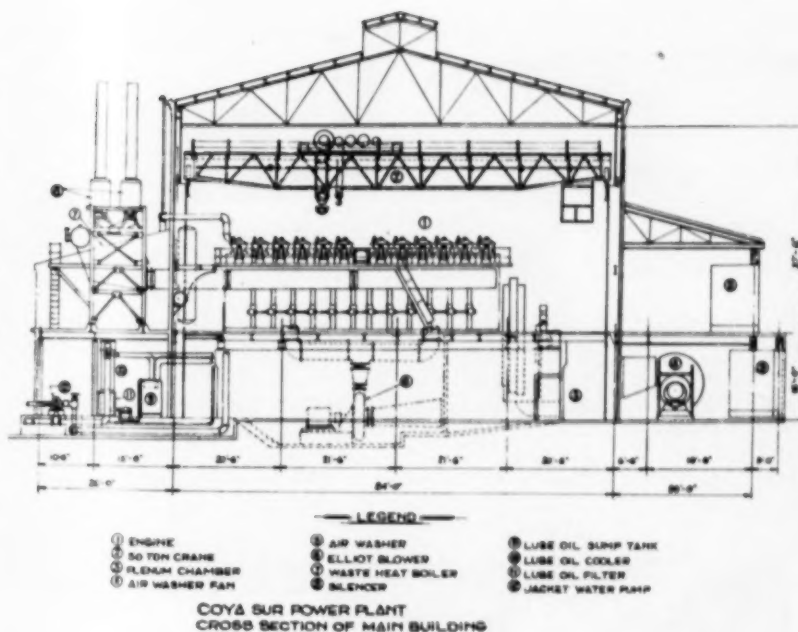
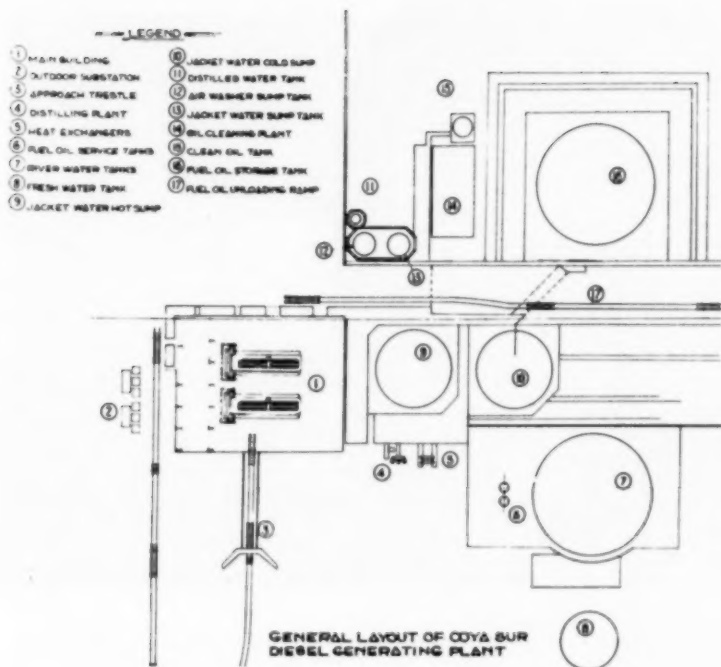
The jacket water cooling system differs from a closed system only by the addition of hot and cold

Air-conditioned control room at Coya Sur showing operator's desk and auxiliary equipment controls.



View between the two large Nordberg generating units at Coya Sur.





sump tanks of 1,000 tons which are open to the atmosphere. The purpose of the tanks is to provide a larger body of cooling water than available with the entirely closed system and a more even water temperature which is easier to control. Instead of cooling towers, this system has heat exchangers in which solutions are heated by the jacket water. Consequently the jacket water is cooled. Water leaves the engine at about 145°F. through a pipe which is elevated slightly higher than the engine to prevent draining of the jackets through pump failure. The hot water discharges into the hot sump from which it flows by gravity to the jacket water heat-exchangers, a distance of about 2,000 feet. The coolers are connected in

series on both solution and jacket water sides.

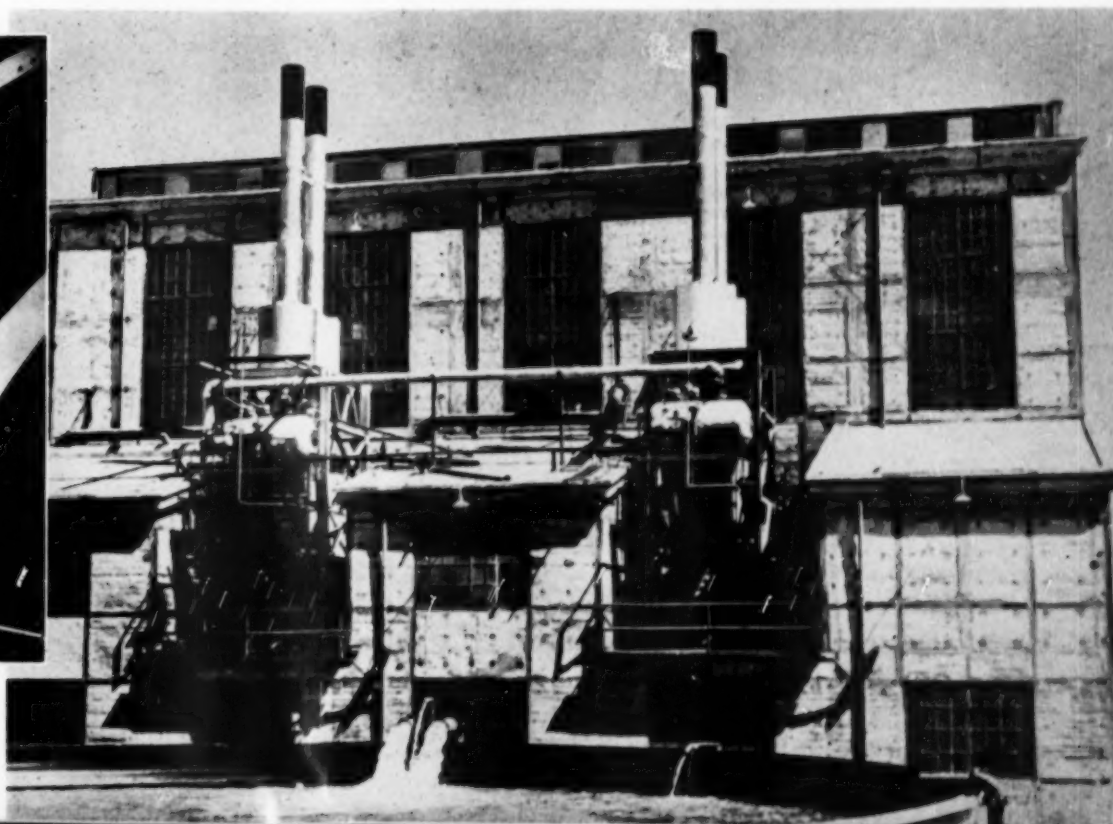
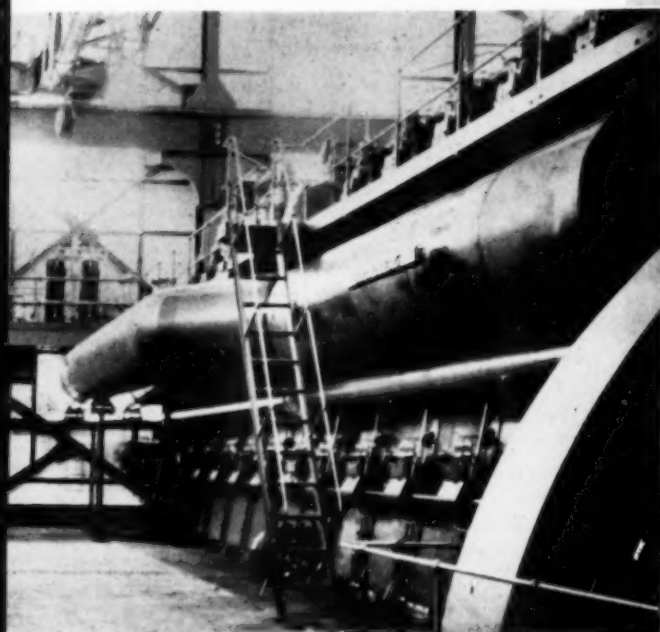
The jacket water from each engine passes first through five coolers, reducing the temperature from 145°F. to 105°F., then is pumped back to the lube oil coolers where water temperature is raised to 115°F. before being discharged into the cold sump.

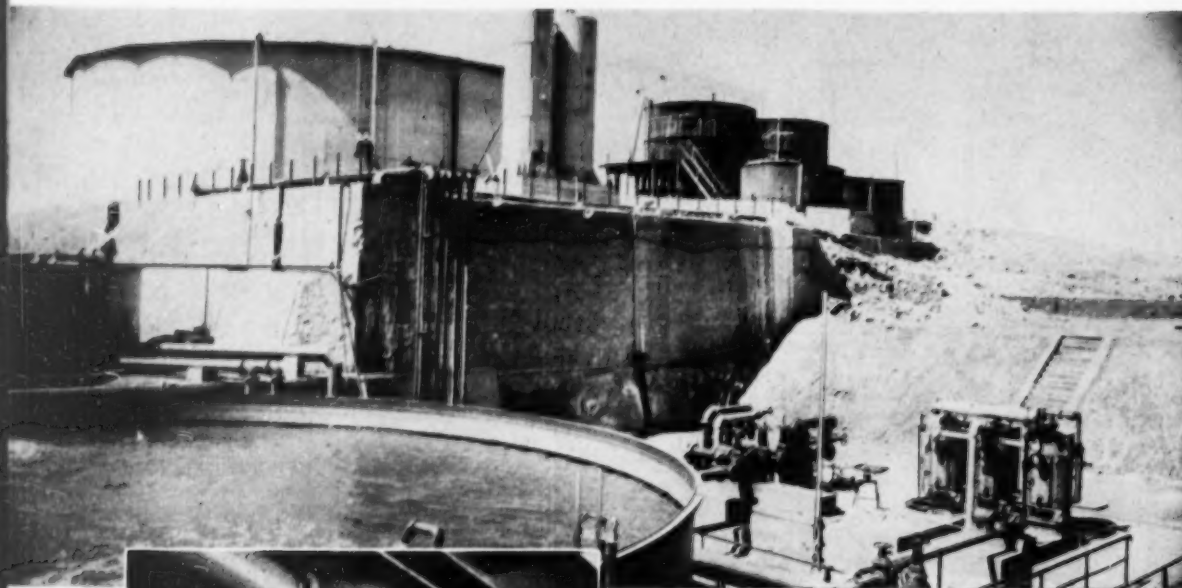
Since the water inlet temperature to the engines should be about 133°F., Sylphon valves are installed to mix water coming from the hot and cold sumps to maintain the proper inlet temperature to the engine. The Combustion Engineering waste heat boilers operating at 25 psig. steam pressure evaporate about 6,500 lbs. per hour of river water each. At the normal operating condition of the engine the exhaust gas enters the waste heat boiler at 450°F. and leaves the boiler at about 350°F. The steam generated is used principally as distilled make-up water for the engines and air washer system.

The Paracoil distilling plant was supplied by the Davis Engineering Co. In addition to the distilling plant, steam heat exchangers are installed that may be used for further heating of solutions in the by-products plant. Since complete machine shop facilities are available at the Maria Elena plant the Coya Sur power plant is provided only with store rooms for spare parts and adequate transportation facilities for repair crews when required. Permanent repair crews are not employed.

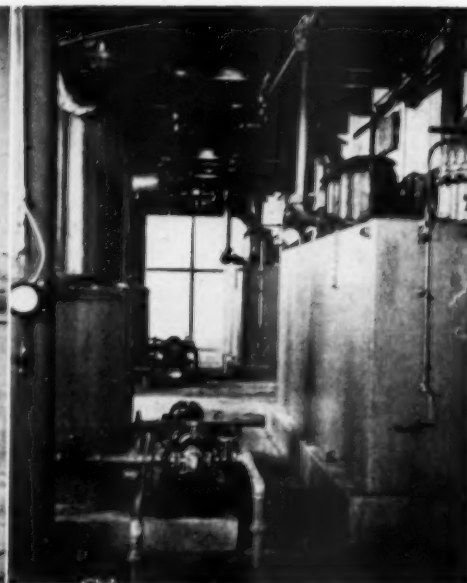
Although it is not, by any means, the largest diesel installation, the Coya Sur plant does have the distinction of employing two of the most powerful single acting, 2-cycle diesel engines ever built in the western hemisphere. Big engines coupled with remote controls, high recovery of waste heat and many new labor-saving operating ideas make this installation truly unique. Coya Sur is already taking a large share of the load and providing reserve capacity to extend railway elec-

Anglo-Lautaro Nitrate Corp.'s Coya Sur power plant is located near Tocopilla, Chile. Shown here are the Combustion Engineering waste heat boilers, hot jacket water sump distilling plant and Maxim Silencer intake silencers.

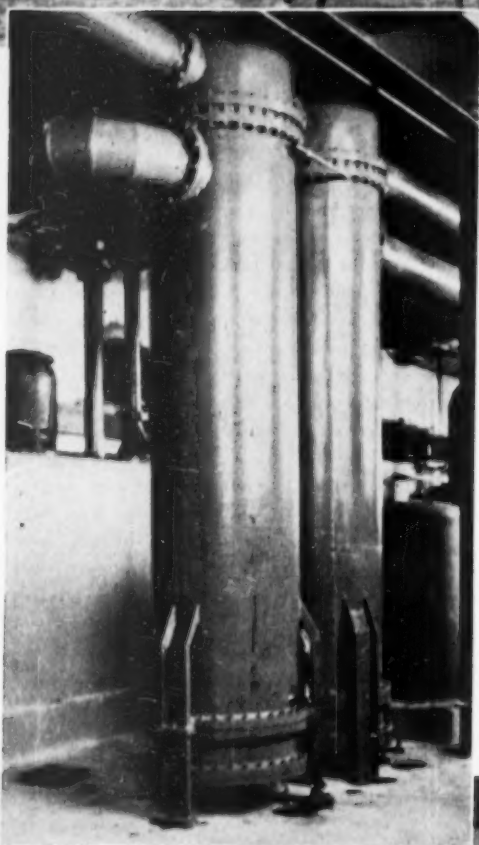




View showing hot jacket water sump in foreground; cold sump on upper left; river water storage; two fuel oil service tanks upper center; distilling plant and heat exchangers at the right.

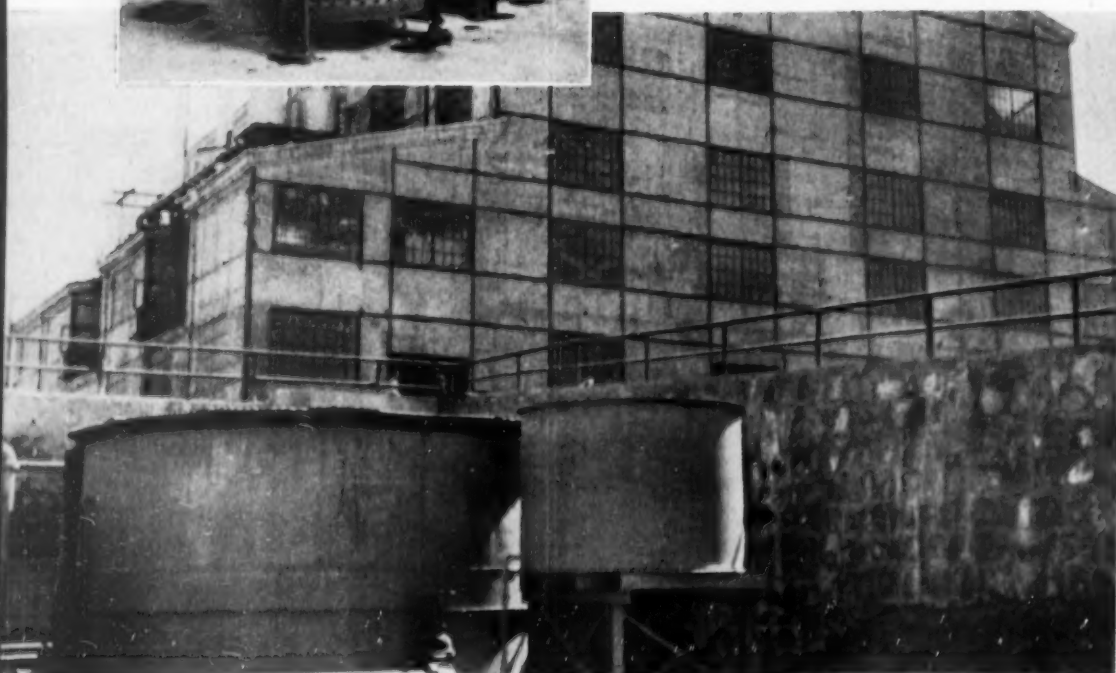


Lubricating oil sump tank, recirculating pumps and Honan-Crane purifiers.



◀ Ross lubricating oil coolers in lower level of the Coya Sur power plant.

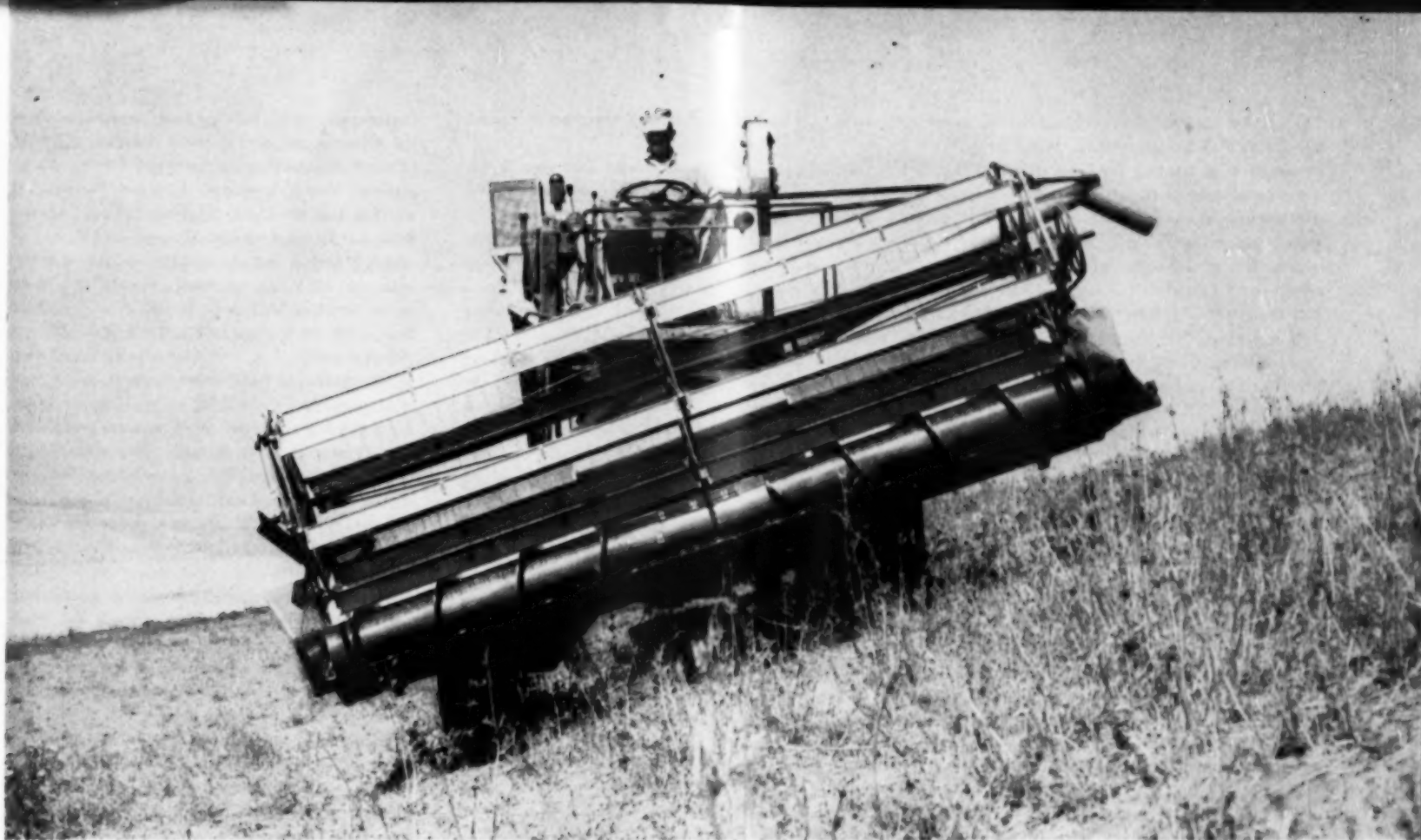
Front view of Coya Sur power house with air washer, sump tank and distilled water tank in foreground.



trification and making it possible to expand production facilities. It is a credit to the Anglo-Lautaro Nitrate Corporation and the Nordberg Manufacturing Co., who supplied the engines and played a large part in the selection of the engines and their accessories.

List of Equipment

Engines—Two-cycle, 12-cylinder, 29" x 40", vertical, mechanical injection, diesel, rated 9600 bhp. sea level, 8950 bhp. at 4166' altitude, 171 rpm. Nordberg.
Generators—6600-volt, 3 phase, 60-cycle, 8,750 kva., 7000 kw.—General Electric.
Exciters—850 rpm., 250 volts, 300 amps. V-belt drive—General Electric.
Exhaust silencers—Maxim Silencer.
Exhaust silencer expansion joints—Zallea Bros.
Motor driven blowers—Elliott.
Lube oil coolers—Ross.
Lube oil transfer pumps—Roper.
Lube oil purifier—Honan Crane.
Lube oil pumps—DeLaval Imo.
Lubricators—Manzel.
Jacket water coolers—Ross.
Fuel oil filters—Nugent.
Fuel oil booster pumps—DeLaval Steam Turbine.
Fuel pumps—American Bosch.
Fuel oil meters—Buffalo Meter.
Switchgear—General Electric.
Waste heat boilers—Combustion Engineering.
Steam heat exchangers—Ross.
Starting air compressors—Gardner Denver.
Governors—Woodward.
Alarm system—Viking Instrument.
Air washers—American Blower.
Exhaust pyrometers—Alnor.
Resistance thermometers—Alnor.
Centrifuges—DeLaval Separator.
Synchronous motors and starters for ventilating fans—Electric Machinery.
Heavy fuel oil strainers—Cuno.
Temperature regulators—Fulton Sylphon.
Liquid level control panel—Automatic Control Co.
Engine indicators—Bacharach.
Vibration insulators—Korfund.



A Baldwin self-propelled combine equipped with Dave Neal leveler caught with its header lifted to show big tires on sidehill in Palouse County.

DIESELS TAKE TO THE HILLS

Increased Population Needs More Acres to Produce Its Traditional 3 Square Meals; Cost of Hill Farming Cut by Big Tires and Power Change-Overs

By F. HAL HIGGINS

Farming more and steeper hills to provide the food and fibre for the mushrooming millions that have been stepping up U. S. population via both stork and shifting populations is definitely in the Pacific Coast picture this year of 1954. Your Old Reporter recently took a look at the famed "Inland Empire" of eastern Oregon, Washington and western Idaho where wheat farming has been the main source of income for more than a half century. Along the Columbia river in Oregon, wheat farming goes back nearly a century.

Horse and mule power in big hitches was naturally the answer to the increased power needed to pull plows, grain drills, and combined harvesters, when the latter machine came in during the 1890's over 60 years ago. The volcanic ash soil that has made the Idaho potato famed for its quality also had its effect on the quality of the grain crops.

But to this soil, the pioneer settlers brought an unlimited mixture of determination, ingenuity and ability to solve their problems of distance from market, to mass produce a crop they could grow and ship half way round the world to beat competition from other exporting areas of the

wheat farming nations. This area is unique in not quitting wheat after doing a pioneer "soil exhausting" job of raising wheat until yields fell to the stage it broke the wheat farmers, and the next owners went to dairy and mixed farming with rotations to build up the soils. The wheat farmers of this area are raising bigger crops of wheat than ever before because of developing better varieties and better farm machines. It included changing from animal to tractor power to give the farmer the ability to speed up operations to take advantage of seasons and get seed in fertilizers, and weed chemicals on land at the right time to a day for best control with harvesting on schedule. The tractor has really given the farmer a chance to get the farm crop work down when it should be done, for big increase in crops and profits. But the biggest tractor cut-lift is in farm labor. The size of the labor crew has been cut to the bone, to a family project in many cases, and the skill of the machine farm hand is far above the old harvest tramp who had no responsibilities or family.

War, and movement of population west for jobs and farms, as well as war service has boomed the

Northwest with increased land harvested for farm crops to practically 30% between 1940 and 1950 census takings, according to Associated Farm Papers surveys. Oregon, Washington and Idaho harvested a little over 11,000,000 acres in 1950.

This was an increase of 1,775,000 acres in a decade, a rise of 29.5% in a decade of World War II and its post-war Korean, and after rise in farm prices that stimulated U. S. farming from ocean to ocean. The high rolling wheat lands of the Palouse and Pendleton areas, and on up and down the Columbia river in both Oregon and Washington, have much larger ranches than the state averages of Oregon, Washington and Idaho. The western fruit, vegetable and dairy farms in the two states that front the Pacific are smaller. Also, the eastern Idaho potato areas bring down the average size in that state from the big wheat operations on the Oregon-Washington border. Average acres per farm are Oregon 359.8, Washington 248.8, Idaho 328.3. Over in the big wheat areas of the Palouse the wheat grower talks in terms of about two sections, or 1280 acres, to allow for summer fallowing, mass production by big diesel tractors, and use of airplane spraying of chemicals.

The earliest horse-drawn combined harvesters sent up to the Palouse and Walla Walla areas were equipped with leveling devices to permit one of the crew of four or five men to manually operate the leveling mechanism by turning a large iron wheel something on the order of the steering wheel. It was a heavy muscle job that gave the operator a workout as the big, old-time combines and mule trains pulling the machines circled the hills at harvest. "Old Man" Holly, a famous sharpshooter in the Civil war, was the Holt salesman who worked out the early side-hill combine leveling devices that went onto these machines sold for hill farming. Many of the side-hill machines carried Holly's name with "Holt" on the canvas-covered rear of the machines.

Competitive machines also had to develop side-hill levellers for the hilly areas. Best and Harris both had levellers on side-hill machines soon after Holt opened up the hills grain areas of the Northwest. So much for the pioneer horse-pull combines from the "Gay 90's" on to the arrival of the first self-propelled combines that also came out of the Holt shops at Stockton before World War I. Some got as far east as the Texas Panhandle and Kansas, and were reported still working in those comparatively level grain fields as late as 1930, at least. Maybe there is one or two still operating. However, rubber on wheels of the modern Massey-Harris, International, Deere (which took over the old Holt combine when Cat decided to concentrate on crawler tractors and road and dirt-moving equipment), Case, Minneapolis-Moline, Allis-Chalmers, Oliver, Ford, Harris and Gleaner self-propelled combines have made the old pre-war combines so obsolete they are disappearing as fast as they wear out, and even faster. Big reason is one-man operation

with bulk tanks instead of sack sewer on the outfit.

The big news of the northwest this year is the arrival of the new models of one-man self-propelled combines in the hills after three years of invention and development of attachments, gadgets, gismos, and gimmicks by farmers, local shops, dealers, plus the factory engineers' refinements of all these to get into production for advertising and sale to the farmers in any hilly areas. The big rubber tires on the combine make climbing of the steepest hills practical as they harvest the grain crop. But for one man to steer and watch his bulk tank's filling and need of stopping to empty, the handling of the old manually-operated levelling devices was not possible without stopping many times on the fast changing grades as the combines moved over and around hills, reversed at end of land being cut, crossed gullies, etc.

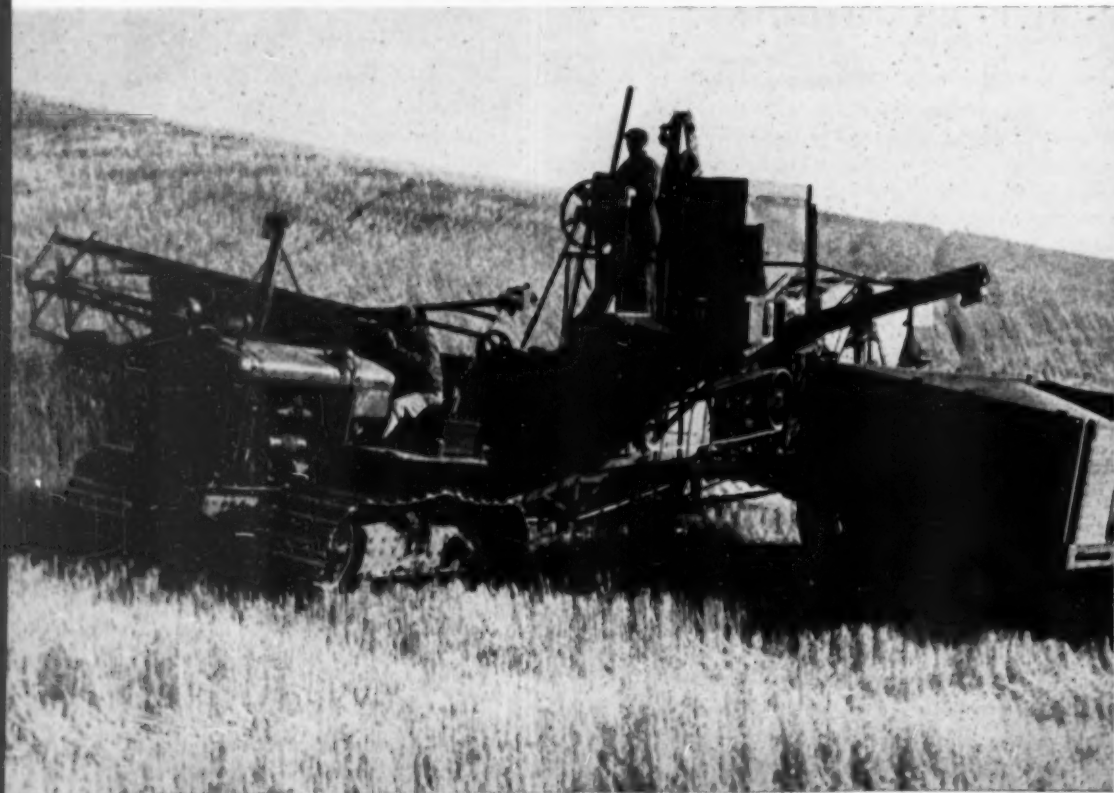
In company with Paul Fanning, agricultural extension engineer at Washington State College, the writer drove around and called on farmers, dealers and little shop operators to see all the different developments. These included: first in the field on the modern self-propelled combines with the big tires was Harris of Stockton, who have always had a big combine business in the Northwest with a branch factory at Walla Walla at one time. Case came out last year with its SPV model. John Deere is starting to advertise its machine that refines a lot of ideas and work brought up from three or four practical inventors in shops at Moscow, Idaho. It was our luck to catch two of the Deere machines as they were being loaded out for the factory at the end of a trial season with the crew of factory engineers operating them in all the hilly fields they could find, where dealers could line up work. The Deere

engineers stopped loading long enough to allow the writer to photograph them and their machine, to show its levelling mechanisms. Deere calls its machine the 55H model. It offers both power steering and automatic levelling control. Everett Will, Cat-Deere dealer at Moscow, and Farber of Idaho Machine and Sheet Metal Co. of same city with one of Will's mechanics worked out many of the levelling features for this Deere machine that is on the market this year. In the office of this dealership, they have framed a photo of their \$8,000 check and hung it on the wall. Dave Neal at Garfield had done a lot of levelling for Deere self-propelled combines the past three years. His leveller now goes on changing over many of the rival machines and the old self-propelled machines still in the hands of farmers who want to get the advantage of one-man operation to cut a man off the harvest job.

Other leveller builders and inventors in the hilly wheat country in the Northwest are R. M. Wade & Co., Portland, distributors for a long line of eastern built farm equipment as well as manufacturers of sprinkler irrigation systems, spreaders, saws, etc.; Hanson & Co., Palouse; W. F. Behrens, Craigmont, Idaho; Wendell Taylor, Malad, Idaho; the Staley-Boyd ranch a few miles below Pullman; and George Sinclair, a rancher with plenty of engineering teaching and practical farm application near Garfield.

But in climbing the hills, most inventors, builders and users find they need a bigger engine than the one used on level land self-propelled machines. Hence, the diesel is ready to step in when one surveys the combine builders and finds that all the full-line farm implement builders with tractors also have diesel tractors now as the farmer

Oliver tractor with Hercules engine pulling bulk combine over Palouse hills a few miles north of Pullman, Washington.



A pair of one-man bulk self-propelled combines wearing the big front tires that permit climbing the steep hills of the Northwest, where wheat has ruled

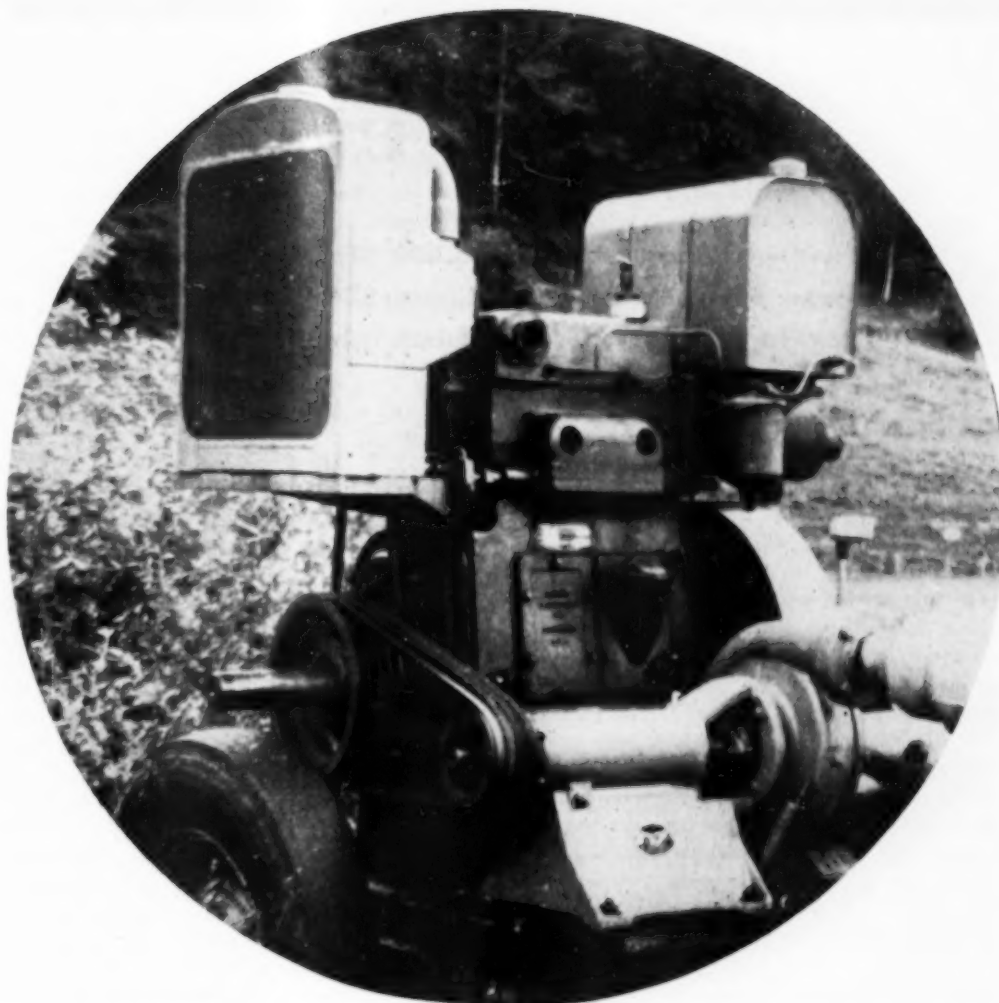


starts re-powering his smaller tractors to cut costs. So Deere, Case, Allis-Chalmers, Massey-Harris, Oliver, International, Minneapolis-Moline can immediately meet the demands by following the wartime lead of Sacramento valley rice-grain growers with diesel to team up with their big crawler diesels on the plow, disk harrow, seeder and rod weeding jobs. It's in the air, even as the engineers debate the economy of having an engine tied up all year for 30 to 60 days harvest work on a combine. The Minneapolis-Moline folks, however, have been out with their "Uni-Tractor", which is a basic carrier for combine, corn picker, picker-sheller and forage harvester. Massey-Harris and other company engineers have been thinking and working on more or less the same idea that would permit the use of one engine in several farm machines for year round use and big economies.

Ford's British diesel tractor may also be aimed at this idea as farm prices decline, and the national burden of price supports fret tax payers to the point of demanding consumption instead of storage by Government of mountains of butter, cotton, corn, wheat, peanuts and rice.

The "big six" oil companies with their great research departments and distribution systems are doing their expected fine job in serving the hill grain farmers in this area where no oil is produced. Pipe line, railroad, river boat and tank trucks bring the diesel, gasoline and furnace fuels, the greases and oils to keep the farm machines and the ranch autos and trucks working in the most efficient wheat production going. Standard, Shell, Union, Richfield, Associated, Texaco, General Petroleum are all in this area and doing a great job, according to the survey made by the Associated Farm Papers.

king for more than half a century. Shown are a Massey-Harris and Minneapolis-Moline combine.



A Lister-Blackstone small diesel for sprinkler system pumping in the Northwest. The engine is rubber-tire mounted for easy towing and is owned by Adolph Molthu, Bullards Route, Oregon.

A TD 14A International Harvester diesel tractor with the wide shoes used in the hilly Palouse country on all tractors. Paul Fanning, Washington State College Extension Engineer, right, has stopped the outfit for an exchange of news.



YOU TOO CAN USE HEAVY FUEL

MURRAY, UTAH

Low-Cost Fuel and New 3,500 Hp. Fairbanks-Morse Diesel Cut Fuel Costs \$50,000 A Year in Murray, Utah, Municipal Plant

UTILIZATION of heavy fuel oil and an improvement program featured by the installation of a 3,500 hp. Fairbanks-Morse diesel have cut costs at the Murray, Utah, Municipal Power Plant more than \$50,000 a year. Rising fuel oil costs in recent years resulted in the conversion of the Murray diesel-electric plant to heavy fuel oil. In order to maintain their very low power rates and still return a profit, Mayor J. Clifford Hansen directed that all means of reducing operating costs be explored. A cooperative venture was undertaken with the nearby Standard Oil Company refinery to burn heavy fuel oil in the plant's diesel engines. Number 5 grade fuel oil is now handled satisfactorily, replacing the more expensive grade 2 diesel fuel. The #5 oil costs only 5.83¢ per gallon compared to 10.89¢ per gallon for #2 diesel fuel.

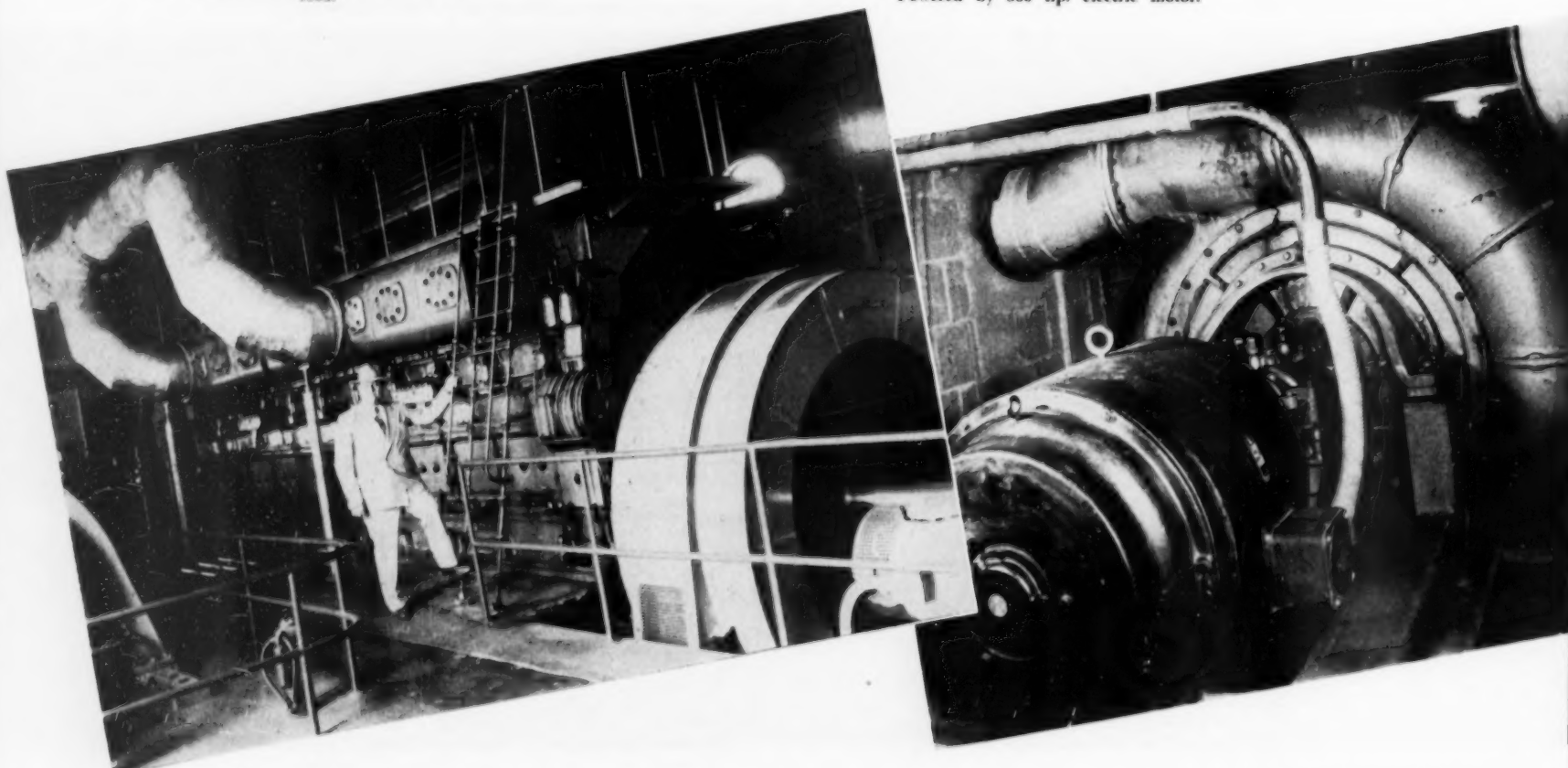
Murray's municipal power plant drew national at-

tention four years ago when DIESEL PROGRESS featured the operation in its July, 1949 issue in an article written by Alfred M. Funk called "Wax Distillate Cuts Fuel Cost." The story told how the Murray plant saved 2.4 cents a gallon by switching from standard fuel to wax distillate.

The heavy fuel oil is delivered hot by truck directly from the refinery and is placed in either an underground tank of 38,000 gallons for immediate use or in a surface tank of 100,000 gallons capacity for storage. Hot water from the engine manifolds is circulated through the oil storage tanks to aid in maintaining a high temperature. Electric cal-rods are also used when needed. The fuel oil is filtered, purified, and electrically heated to 160 degrees F. on its way to the engines where it is again filtered before injection into the cylinders. During the first year's operation, some difficulty was expe-

Mayor J. Clifford Hansen was one of leading proponents for conversion to heavy fuel oil. Pictured here by the new Fairbanks-Morse installed in July 1952.

Roots-Connorsville Scavenging Blower for 3500 hp. Fairbanks-Morse diesel. Powered by 300 hp. electric motor.





rienced with injection nozzle failure on the older engines. Though the savings in fuel costs more than offset the cost of nozzle replacements, the nuisance and lost time made it imperative that a solution be found. Through efforts of the refinery, the oil composition was altered slightly and better filtering was installed at the plant. Since these changes were made two years ago, no further difficulty has been encountered and nozzle replacements are now at a minimum. The fuel oil as supplied has a high heat value of 147,300 btu. per gallon and a sulphur content of 1.2%. This high sulphur content necessitates the use of a heavy-duty detergent lubricating oil in the crankcase of the engine as well as in the cylinder lubricators. No engine wear has developed which is attributable to the heavy fuel oil.

Lubricating oil consumption is slightly higher than for lighter fuel.

As is to be expected, the sticky heavy fuel oil makes the plant very hard to keep clean. The operating personnel are to be commended for their successful efforts in this direction. Murray's power supply consists of their diesel-electric plant, an 80 kw. low head hydro plant located in the foothills of the nearby Wasatch mountains and an emergency power connection with Utah Power and Light.

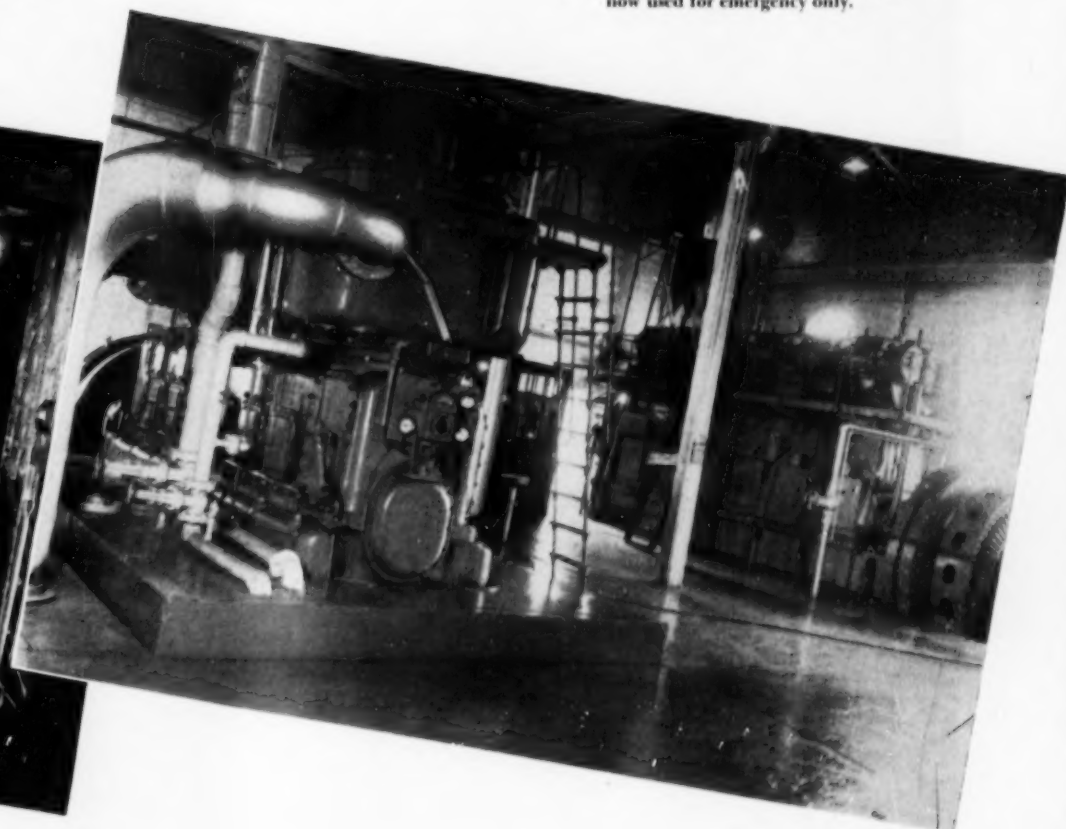
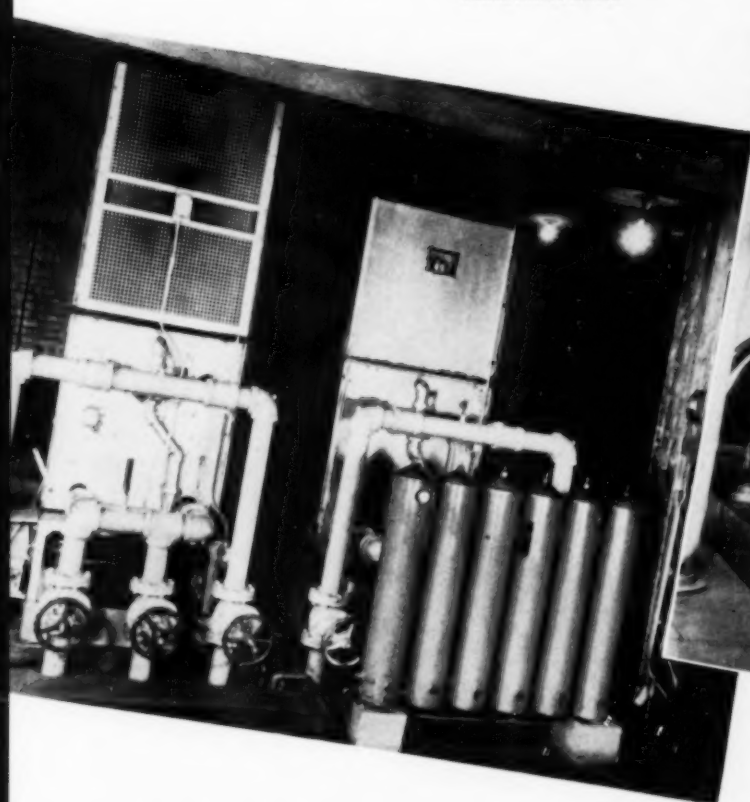
Five diesel units are installed with four currently in use. The newest unit, a 3,500 hp. Model 31A18, 10-cylinder Fairbanks-Morse diesel, went on the line in June 1952. It was purchased with the understanding that #5 fuel oil would be used. No operating troubles at all have arisen with use of heavy fuel in this engine. The oldest unit in the

plant is a 6-cylinder, 675 hp. air injection Fulton diesel installed in 1927, now used for emergency service only. A 6-cylinder Model 33 Fairbanks-Morse diesel, rated at 840 hp. was installed in 1937 and in 1948 two 8-cylinder SEH 1645 hp. Worthington diesels were added. A total of 4850 kw. is now available at the diesel plant without the air-injection unit. The hydro develops full load only during the summer run-off. In winter, when the peak load occurs, it is available for only about 300 kw. During the year it will develop about 20.25% of the power generation and, of course, at a very low operating cost.

The peak demand for the system last season was 5200 kw. in December 1953 as compared to 3270 peak in December 1949. This represents about a 15% yearly increase in load. The 5200 kw. peak load was distributed among units as follows: 2200 kw. new Fairbanks Morse, 1050 kw. each Worthington, 500 kw. old Fairbanks-Morse and 400 kw. hydro. The new 3500 hp. F.M two cycle diesel is scavenged by a separate 30 hp. electric motor-driven blower. The air supply is brought into the basement through large grilled areaways where it is cooled and humidified by water sprays. The air is then filtered before entering the suction duct of the blower. The filter bank consists of replaceable impingement type elements. The exhaust silencers are located above the engines at the front of the building. They are hidden behind the parapet walls of the building so are not visible from the outside. This together with the basement air intake adds much to the neat external appearance of the plant. Because much of the engine heat is transferred by the cooling water to the heavy fuel

Fairbanks-Morse Lube Oil Filter and Fairbanks-Morse Evaporative Cooler in service with the new 3500 hp. Fairbanks-Morse diesel.

Model 33 840 hp. F-M Diesel in foreground also operates successfully on heavy fuel oil. In background is air injection Fulton Diesel installed in 1927, now used for emergency only.



oil, a smaller load is placed on the evaporative type water coolers located at the front end of the engine room. Water is circulated through a shell and tube lube oil cooler. Makeup water for the engine jackets is softened by means of a sodium zeolite softener.

The electric switchboard is located in an adjacent glass-walled room. This removes the operator from much of the engine noise making working conditions much more pleasant. Signal horns are provided for all auxiliaries, and all critical pressures and temperatures. At the engines, control panels give readings for the scavenging air pressure, jacket water pressure, lube oil temperature, lube oil pressure, lube oil cooling water temperature, fuel oil pressure, and starting air pressure.

In its first full year of operation (June 1952 through May 1953), the 3,500 hp. F-M diesel produced 8,479,000 kilowatt-hours. Fuel consumption was 652,685 gallons, an average of 13 kw. hrs. per gal. Some months, when conditions were more favorable, the average was as high as 13.9 kw. hrs. per gallon. In the five months preceding installation of the new engine, plant average was 12.14 kw. hrs. per gallon. With No. 5 fuel at 5.83 cents a gallon, the big engine produced a kw. hr. for a fuel cost of 4.48 mills. Compared with the older unit's performance on the 10.89 cent light fuel, this represented a saving of \$37,000 on the new engine's production. For the entire plant, the use of heavy oil instead of regular diesel fuel during 1952 saved more than \$50,000. See Table I for additional operating statistics. The Murray Municipal Power Department has returned a net profit of \$26,378.27 on sales of \$87,213.10 during the first three months of

TABLE I

**Murray, Utah
Operating Statistics
3500 Hp. F-M Diesel**

Month	Kwhr.	Fuel Gal.
1952 June	234,000	18,000
July	454,000	34,923
Aug.	489,000	44,429
Sept.	814,000	58,925
Oct.	830,000	63,846
Nov.	831,000	63,168
Dec.	899,000	64,914
1953 Jan.	813,000	66,140
Feb.	809,000	61,299
March	816,000	63,307
April	761,000	57,868
May	729,000	55,866
	8,479,000	652,685

Average kwhr. per gallon fuel oil 13.0 for 3500 hp. F-M. Average kwhr. per gallon fuel oil entire plant, 12.48. Average fuel cost 4.48 mills/kwhr. for 3500 hp. F-M.

	Kwhr.
Total diesel power generation 1952	14,032,700
Total hydro power generation 1952	4,638,700
Total purchased power 1952	559,868

Savings for diesel power generation for 1952 by use of #5 fuel instead of #2—more than \$50,000.

Total 1953 figures: Kwh. generated F-M, 8,988,000; fuel oil consumed, 698,433 gals.; average kwh. per gallon, 13; fuel cost per gallon, 6¢; fuel cost per kwh., 4.61 mills.

1953. At the same time it boasts one of the lowest rates in the U. S. with 500 kwhr. for domestic use costing only \$7.20. It serves some 3845 residential and commercial accounts in a city of 10,250 inhabitants located just south of Salt Lake City.

The savings in fuel cost by use of heavy fuel oil is aiding materially in maintaining such low rates and high income. The plant used 1,387,000 gallons of fuel oil in 1953, realizing a saving of 5 cents a gallon, or \$69,350 for the year.

List of Equipment

Engine—3500 hp. Fairbanks-Morse diesel, 10-cylinder, 18 in. bore x 27 in. stroke, two cycle, 277 rpm., Model 31A18.
Generator—2200 kw. at 4350 feet. Fairbanks-Morse, 2400/4160v., 3410 kva., 277 rpm., 60 cycle, 3 phase.
Exciter—30 kw. Fairbanks-Morse, 125v., belt-driven.
Blower—Roots-Connorsville Blower Corp. 300 hp. motor-driven.
Governor—Woodward.
Fuel oil—Standard Oil.
Fuel oil heater—Honan-Crane.
Fuel oil filter—Nugent.
Fuel oil meter—Niagara.
Lube oil—Continental Oil.
Lube oil cooler—Ross.
Lube oil purifier—Honan-Crane.
Lube oil filter—Fairbanks-Morse Co.
Evaporative water cooler—Fairbanks-Morse Co.
Air filter—American Air Filter.
Exhaust silencer—Maxim.
Voltage regulator—General Electric.
Pyrometer—Alnor.

Separate glass enclosed switchgear room aids much in operator comfort. One of the two 1645 hp. Worthington Diesels installed in 1948 also shown.



"J. W. ROSE"

IN the autumn of 1953, young Barry Dean Rose christened the new diesel towboat *J. W. Rose*. Like its older sister ship, the *Barry Dean*, the *J. W. Rose* was designed and built by the St. Louis Shipbuilding & Steel Co. for the Rose Barge Line. Since its launching, the craft has delivered economical and dependable service for its owners.

The 800 hp. twin screw *J. W. Rose* represents the best in modern towboat design and equipment. The 90 ft. x 26 ft. x 8 ft. 6 in. hull has extremely easy lines from its modified V bow to the well rounded tunnels, providing a nonturbulent flow of water to the propellers. Each 66 in. diameter propeller is driven by a 400 hp. Caterpillar D397 marine diesel engine with Falk 4:1 reverse-reduction gear. To increase the pushing power by approximately 30%, the *J. W. Rose* is fitted with specially designed St. Louis Ship Kort nozzles and Contraguide rudders. As the first installation on a river towboat, to further increase the propulsive efficiency of the *J. W. Rose*, a tear-drop shaped bulb was added to each Contraguide rudder. The flow of water from all propellers creates a vortex of turbulent water and air just aft of the hub which cuts down propulsive efficiency. The new device fills this cavity, permitting a smooth flow of water aft, thus increasing thrust and leading to improved rudder action.

Structurally, the rugged hull far exceeds the requirements of the American Bureau of Shipping. The vessel is framed longitudinally and transversely with plating of $\frac{3}{8}$ in. on the bottom and sides. The decks and bulkheads are $\frac{1}{4}$ in. plate with the latter being stiffened both vertically and horizontally. For dependability as well as maneuverability, the *J. W. Rose* is equipped with two St. Louis Ship electro-hydraulic steering systems. One controls the two Contraguide steering rudders and the other the four flanking rudders. 220 volt ac. power is provided by two Caterpillar D315, 30 kw. diesel generator sets. A Lake Shore Electric Corp. switchboard provides for generator control and distribution of light and power. For cooling the jacket water of the propulsion and generator diesels, St. Louis Ship closed type skin cooling ducts are used. Compressed air for engine starting and the air horn is provided by a 3 hp. motor driven Gardner Denver compressor.

List of Equipment

Main engines (2)—Caterpillar D397 marine diesel, 12 cylinder, $5\frac{3}{4}$ in. x 8 in., each rated at 400 hp. at 1200 rpm.

Exhaust silencer—Burgess-Manning.

Sanitary and potable water pressure sets (2)—Fairbanks-Morse, shallow well type.

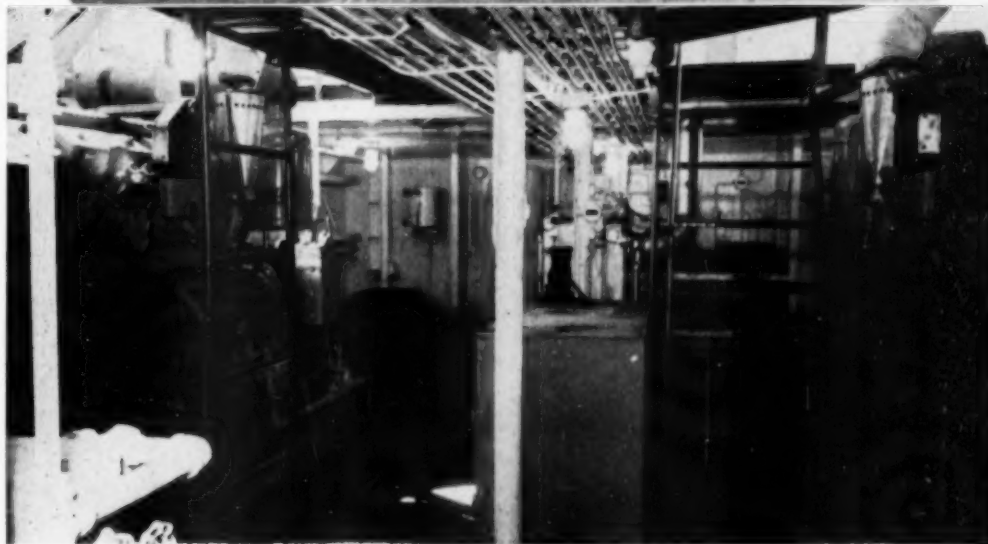
Auxiliary generator sets (2)—Caterpillar D315 diesel electric generator sets. Each set includes a four cylinder $4\frac{1}{2}$ in. bore, $5\frac{1}{2}$ in. stroke diesel engine and an externally regulated 30 kw., 3/60/240 volt generator.

Generator exhaust silencers (2)—Burgess-Manning.

Switchboard—Lake Shore Electric Corp.

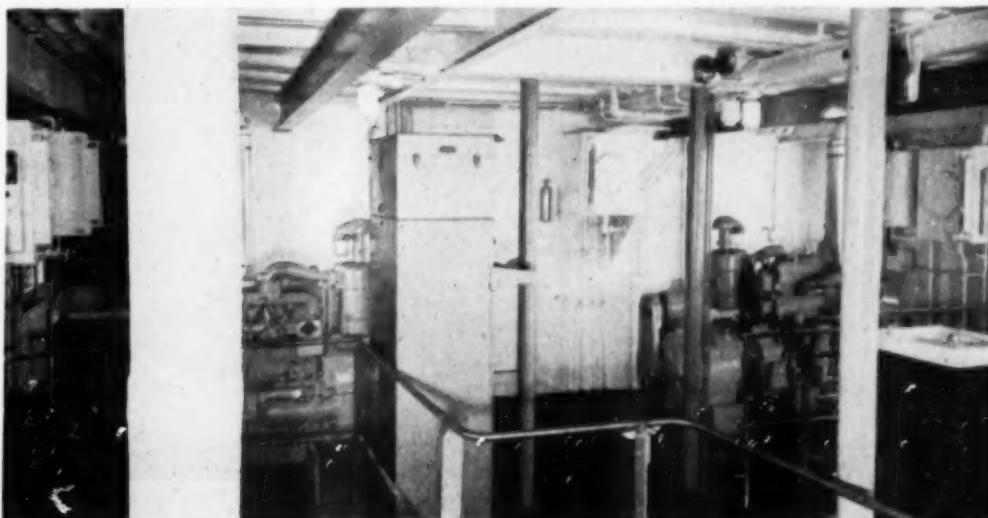
Air compressors—Gardner Denver.

Heating convectors—Trane.



Two Caterpillar Model D397 diesels provide the main propulsion power for the *J. W. Rose*. This view is of the lower engine room looking aft.

Upper engine room looking forward showing the two Caterpillar D315 diesel electric generating sets which furnish the auxiliary power for the *J. W. Rose*.



TOWBOAT "A. H. CRANE"

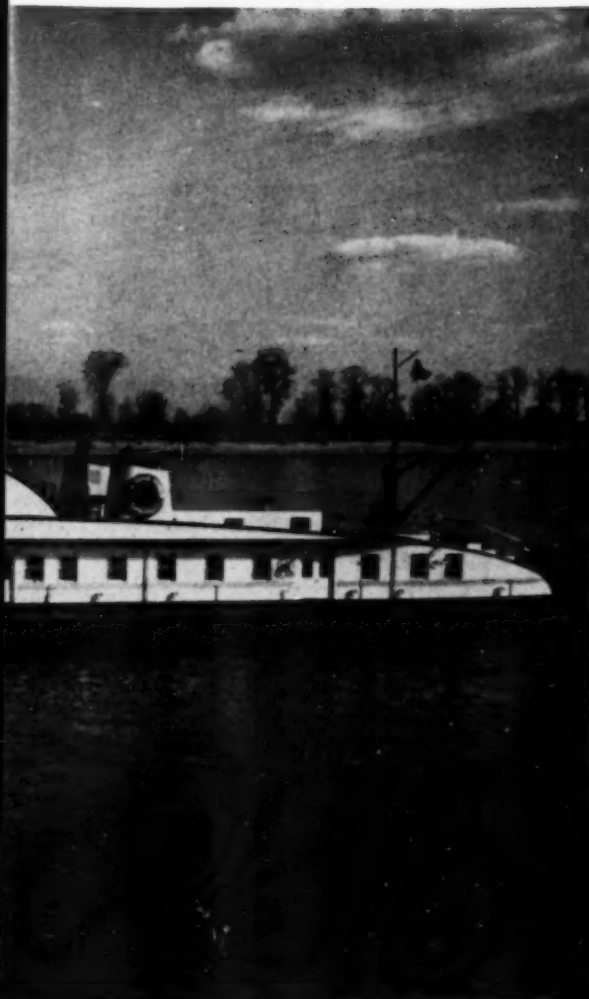
Soon to enter the coal trade on the Ohio River is the ultra-modern towboat *A. H. Crane*. Designed and built by the St. Louis Shipbuilding & Steel Co. for the Ohio River Co. of Cincinnati, Ohio, the *A. H. Crane* bears the name of the secretary treasurer of West Virginia Coal & Coke Co., and its subsidiary, the Ohio River Company. The new towboat which will handle coal barges for the new plants of the Ohio Valley Electric Corporation, is the 13th in the fleet of the Ohio River Company and the fourth built by St. Louis Ship. The *A. H. Crane* is 140 ft. in length, by 35 ft. in breadth, with a normal draft of 6 ft. 6 in. The sturdy hull is framed on the transverse and longitudinal system with scantlings exceeding that required by the American Bureau of Shipping. The bottom and side plating is $\frac{3}{8}$ -in. thick, the bilge and tunnel plating $\frac{1}{2}$ -in. and all bulkheads are $\frac{3}{8}$ -in., stiffened both vertically and horizontally. The well developed stern lines permit water to

enter the propellers as easily from the sides as from the bottom. Specially designed Kort Nozzles give the 2100 hp. *A. H. Crane* an increase of over 25% in pushing power.

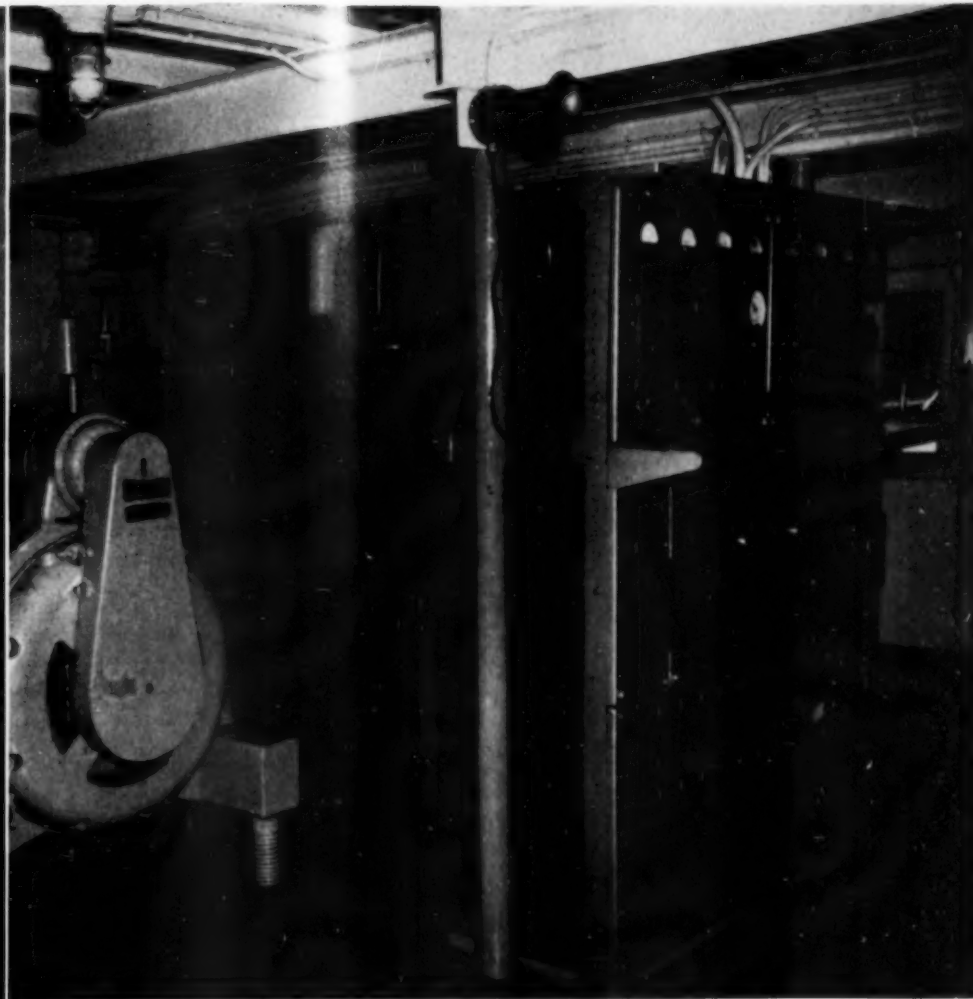
Propulsion is provided by two Baldwin-Lima-Hamilton Model 606-Sc 6 cylinder, supercharged, 12 $\frac{3}{4}$ -in., 15 $\frac{1}{2}$ -in., 4 cycle, marine diesel engines, the first such installation on a river towboat. Each engine is rated at 1080 hp. at 600 rpm. Through Falk Model 12MB reverse and reduction gears with 2.516:1 ratio and Airflex clutches, the 92-in. diameter four blade cast steel propellers turn at 238 rpm. The main engines and reduction gears are arranged for complete pilot-house control by means of Morse mechanical controls. The cooling of the main engines is accomplished by circulating the jacket water through St. Louis Ship closed skin cooling ducts. There are also Graham lube oil coolers and Hilco lube oil purifiers.

The engine room of the *A. H. Crane* showing the two supercharged Baldwin-Lima-Hamilton marine diesels. Each engine is rated at 1,080 hp. at 600 rpm. Featured are Hilco lube oil purifiers and Graham lube oil coolers.





Entering the Ohio River coal trade is the ultra-modern diesel towboat *A. H. Crane*. She is 140-ft. in length and 35-feet in breadth with a normal draft of 6-ft. 6-in.



Electric power is provided by two Caterpillar 75 kw., 220 volt ac. diesel generator sets. The dead front switchboard for control and distribution of power, shown above, was manufactured by the Lake Shore Electric Mfg. Co.

The *A. H. Crane* is equipped with two powerful steering systems of the St. Louis Ship mechanical-hydraulic type. One system controls the two steering rudders and the other controls the four flanking rudders. The system is so designed that the rudders can be turned hard-over to hard-over in 12 seconds while towing. Electric power is provided by two Caterpillar 75 kw., 220 volt ac. diesel generator sets. The dead front switchboard for control and distribution of power was manufactured by the Lake Shore Electric Mfg. Co. The 100 gpm. Goulds fire pump, driven by a 7-1/2 hp. Fairbanks-Morse motor with Cutler Hammer controls, supplies four fire hose outlets. A Gorman-Rupp bilge pump, driven by a 5 hp. Fairbanks-Morse motor with Cutler-Hammer controls has suction connections from all compartments.

A 3/4 hp. Goulds motor driven pump provides for the efficient transfer of fuel oil between bunker tanks, while for pumping from bunker tanks to day tanks there is a 3/4 hp. fo. service pump. Two 23.5 cfm. Quincy air compressors driven by 5 hp. Fairbanks-Morse motors with Cutler Hammer controls, provide air for main engine starting, airflex clutches and air whistle. An oil fired Crane boiler furnishes hot water to the heating connectors throughout the boat. Two double barreled capstans and two deck winches, all manufactured by Schoellhorn Albrecht Co. are each powered by 10 hp. hydraulic motors. Power for the hydraulic

motors driving capstans and winches is provided by 2-10 hp. motor driven hydraulic pumps.

The extremely spacious pilot house, affording clear vision in all directions, has a front window of special Ohio River Co. design. In the pilot house console are located the Morse engine control stand and two pairs of steering levers. The radar set is a Raytheon Model #1404, and the radio-telephone is a Radiomarine Corporation of America model ET8050HF. Two 19-in. 35 amp. Carlisle & Rinch arc searchlights are located on the upper deck with manual control from the pilot house, dc. power is provided by a 10 kw. dc. generator driven by a 15 hp. motor. An 8-in. Triplex Kahlenberg Bros. air whistle is located on the pilot house roof. The *A. H. Crane* should prove a worthy addition to the fleet of one of our outstanding river operators.

List of Equipment

Main Engines—Two Baldwin, Model 606 S.C., 6-cylinder, supercharged, 12 1/4-in. x 15 1/2-in., 4 cycle, each rated at 1080 hp. at 600 rpm.
Reverse-Reduction Gears—Falk, Model 12 MB, Ratio 2.516:1 with two Airflex Clutches.
Exhaust Silencers—Burgess-Manning.
Pilot House Controls—The Morse Institute.
Lube Oil Coolers—Graham Mfg. Co.
Lube Oil Purifiers—Hilco.

Fuel Oil Filter—Hilco.

Kort Nozzles—St. Louis Shipbuilding & Steel Co.
Aux. Generator Sets—Two Caterpillar, each 75 kw, 3 phase, 60 cycle, 220 volt ac.

Switchboard—Lake Shore Electric Mfg. Co.

Generator exhaust silencers—Burgess-Manning.

Air Compressors—Quincy Compressor Co. 23.5 cfm. driven by 5 hp. Fairbanks-Morse electric motors with Cutler-Hammer controls.

The pilot house is spacious and affords clear vision in all directions. The pilot house console holds the Morse control stand and two pairs of steering levers.





WHAT'S GOING ON IN ENGLAND

CONDUCTED BY HAMISH FERGUSON

Hamish Ferguson received his training and early experience with the English Electric Company. Subsequently, he spent a number of years with a firm of diesel engine consultants, London, and in 1944 became secretary to the Diesel Engine Users Association. In 1953, he relinquished his appointment to devote his time to private consulting work connected with diesels and gas turbines.

THE ROVER SMALL GAS TURBINE

The first of Britain's small gas turbine units to go into production is the Rover IS/60 which is designed and manufactured by Rover Gas Turbines Ltd., Solihull, Birmingham. Following the inception of the 250 hp. turbine unit fitted in the world's first gas turbine car, Jet. 1, the decision was taken to concentrate on production of two smaller engines, both having as many common parts as seemed practicable. One of these was to be a 60 hp. industrial engine of the "single shaft" type, without any heat exchanger; while the other, a "two shaft" unit with heat exchangers, was to be suitable for propelling vehicles and boats. The first of these two is now in production, and is the one here described.

The main component of the turbine engine is the cast aluminum alloy compressor housing with its two screened air intakes, one on each side. Within the housing, mounted on a single shaft, are a single-stage centrifugal compressor of forged aluminum alloy with steel inlet guide vanes, and an axial flow turbine of Nimonic alloy. The shaft is supported in two bearings, a roller bearing in front of the turbine rotor and, at the compressor end, an angular contact ball bearing which locates the shaft and absorbs axial thrust. At the forward end of the compressor housing a mounting plate is fitted for the auxiliaries and this carries the pressure oil pump and the feed control unit. These are driven from the turbine shaft at re-

duced speed by an internal train of gears. A shaft integral with the intermediate wheel of this gear train protrudes through the mounting plate and carries the power take-off pinion.

Attached to the rear end of the compressor housing is the fabricated sheet metal main casing which houses both the air duct from the compressor to the combustion chamber and the volute carrying the combustion gases to the turbine rotor. This main casing also carries the bearing housing support plate which locates the turbine roller bearing. The diffuser ring is attached to the bearing housing support plate, and bolted to the rear of this is the turbine nozzle support ring assembly, secured in the combined nozzle and turbine shroud by a series of pegs. These parts are protected by a cooling ring and heat shield from excessive transfer of heat from combustion products. A Nimonic alloy exhaust cone is secured to the turbine shroud flange at its inner end, the rear flange of the cone being attached to a flange formed on the main casing. The two exhaust cone flanges are interconnected by flexible metallic bellows which permit the cone to expand without distortion. A single combustion chamber, embodying the ignition plug and burner, is bolted to a flange on the front of the main casing. This provides a high heat release incorporating either a spill type or a variable flow, pressure sensitive, burner. Initial ignition is by means of an igniter plug connected to a generator operated in conjunction with the starting mechanism.

The operation of the turbine is quite simple. Air is admitted through the side intakes to the compressor rotor, is compressed and then passed along the air duct to the combustion chamber where fuel is injected. The resulting mixture is then ignited and the combustion gases pass through the volute to the fixed nozzle ring assembly which directs the gases to impinge against the turbine rotor blades. The combustion gases then exhaust to atmosphere through the exhaust cone.

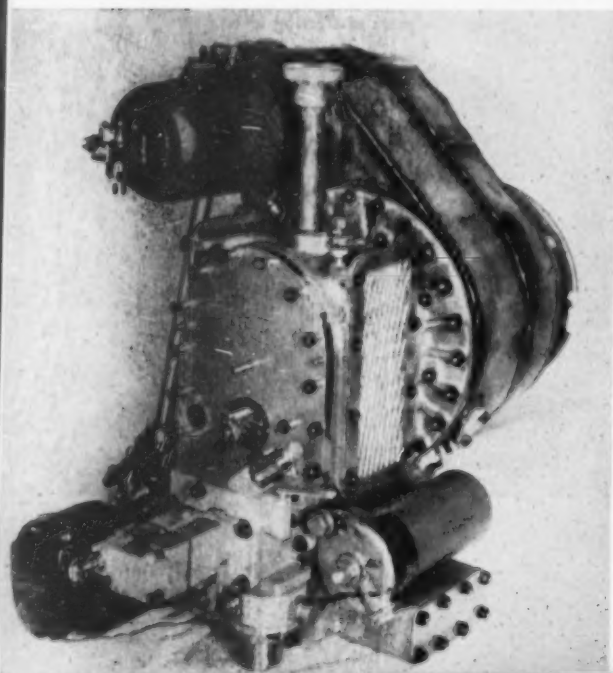
The following advantages are claimed for the gas turbine as against other types of prime movers: (1) Low specific weight and bulk. (2) Greater reliability, due to the smaller number of parts, hence decreased maintenance and spare parts costs. (3) Complete absence of all vibration effects due

to perfect engine balance; hence virtually no foundations are needed for small units. (4) Any distillate fuel may be used. (5) Ease of starting from cold. (6) The basic shape of the turbine unit renders it more convenient to install, especially in aircraft, locomotives and other vehicles. (7) Decreased consumption of lubricating oil. (8) Smokeless exhaust under all operating conditions. Against these must be set the disadvantages, such as higher fuel consumption, and sensitivity to changes in air temperature.

There would appear to be a wide field of application for the small gas turbine. Its low weight makes the unit readily mobile and it can be incorporated into either portable fire pumps, electric generators or air compressors. Since there is no restriction as to the fuel which can be burned, the unit can be employed wherever a supply of liquid or gaseous fuel, natural or artificial, may be tapped. Further applications include the use of the turbine as an auxiliary power plant for large multi-engined aircraft. Here, the compactness, light weight, and freedom from vibration, coupled with speed governing within $\pm 1\%$, are attractive. Even when the aircraft is on the ground this type of auxiliary power plant has its advantages as the complete schedule of ground testing of auxiliaries can be carried out without running the main engines, resulting in a large fuel saving. Similarly the turbine may be used for driving marine auxiliaries and ship board fire pumps. With its ability to operate on gaseous fuel it can be used to provide power at the pit-head using upcast air, or when using blast-furnace gas, as a low pressure furnace blower.

Performance Data

Rated power	60 bhp. at 60°F (15°C)
Maximum R.P.M.	46,000 (compressor shaft)
Output Shaft R.P.M.	To customers' requirements.
Specific fuel consumption	1.46 lb./bhp. H. (kerosene)
Air mass flow	1.35 lb./sec.
Compression ratio	2.9 to 1
Maximum jet pipe temperature	600°C (1,110°F)
Maximum gas temperature	790°C (1,452°F)
Dry weight (bare engine)	116 lbs. - 2.5%
Overall thermal efficiency	9.5% at 50°F
Power/Weight ratio	1.93 lb./B.H.P.



Mid-Continent Diesel News

By Jack F. Cozier

HALLIBURTON Oil Well Cementing Co., Duncan, Okla., has purchased several International Harvester trucks equipped with Cummins JBS-600 diesel engines. The trucks will be delivered in Duncan to be used in oil well cementing operations.

FORTIER & WRIGHT Drilling Co., Wichita, Kan., has purchased a model 20 Murphy diesel rated at 135 bhp. at 1200 rpm., to be used for powering a 7¼ by 10 FXO Gardner-Denver mud pump. The unit was sold by the Manufacturers Distributing Co. of Great Bend, Kan., for use on a rig in Cowley County, Kansas.

THE CITY of Cherokee, Okla., has purchased an LS 6-cylinder, 3-way Cooper-Bessemer diesel engine generating unit for a municipal power plant.

MORE THAN \$110,000 worth of LeRoi engines in one shipment have moved recently into the oil fields of Texas and Oklahoma for use in the oil industry.

SIMPLLOT Fertilizer Co., Salt Lake City, Utah, has purchased a model 21 Murphy diesel, powering a Northwest 80-D power shovel. The unit is located in Wyoming.

HEAVY-DUTY power is supplied for the Southwest Construction Materials Co., Dallas, Texas, by Cummins diesel engines. Locomotives used are General Electric products. Two of the units use two HRBI-600 Cummins diesels each, and the third locomotive uses one HRBI-600 Cummins diesel.

SIX MODEL DT-317 Buda diesel engines were sold recently by the Buda Engine & Equipment Co., Tulsa, Okla., to be used on small rotary rigs.

ON DISPLAY at Midwestern Engine & Equipment Co., Tulsa, is a new dual fuel Continental air-cooled oil field V-12 engine. This unit previously was restricted to use by the armed services, but now it has been released for public sale. The engine develops 450 hp. and a rating of 1800 rpm.

AMIS CONSTRUCTION CO., Oklahoma City, has recently acquired a Murphy diesel model 21 powering a Northwest 80-D power shovel.

BUDA Engine & Equipment Co., Tulsa, has reorganized as a wholly owned subsidiary of the Allis-Chalmers Mfg. Co. The Tulsa division covers the Oklahoma, Kansas and Texas oil regions.

Cooler Catalog Available

An 8-page, 3-color catalog (No. 1054) illustrating the new Young torque converter cooler line has just been issued by the Young Radiator Co. of Racine, Wis., and Mattoon, Ill. This line of coolers is engineered for mobile or stationary application from 100 to 600 hp. for oil-to-air or oil-to-water cooling of power equipment, using straight hydraulic or hydraulic and mechanically clutched transmissions. Copies of the catalog may be obtained by writing Young Radiator Co., Racine, Wisconsin.

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2425 North Wolcott Avenue

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YOU TOO CAN USE HEAVY FUEL

The Fourth of a Series of Articles on the Successful Use of Heavy Fuel in Diesel Engines.

ALARGE oil company located in the midwest recently found itself in a puzzling situation. To operate its pumps, it had on hand a battery of high-output, 8-12 cylinder V-type diesel engines with multiple-plunger injectors having extremely small clearance between the plungers and cylinders. But the oil company found these engines were useless for pumping operations using conventional fuel because they were located in extremely rough terrain and at such a great distance from highways and roads that transportation of No. 2 fuel for their operation was not practical.

How to solve this problem? The only solution appeared to be the use of crude fuel drawn directly from the oil well itself. However, it was obvious that such a program would be impossible without a filtration system to eliminate the large amount of impurities inherent in the crude oil. A laboratory analysis of the crude oil disclosed the following:

Gravity API at 60°F.....	37.1
Flash	Below room temp.
Vis. S.U. at 100°F.....	44.4
Aniline Pt. ° F.....	139.1
Neut. No. Mgl gm.....	19 Acid
B.S. & M. % by vol.....	15
Chlorine07
Doctor's Test.....	Pos.
Sulphur %.....	.23
% Ash.....	.02
% Carbon Residue.....	1.99
Cetane No.....	46.2
Diesel Index.....	51.6
H ₂ S	Pos.
H ₂ O by Distillation.....	Trace

DISTILLATION	
I. B. P. ° F.....	160
5%.....	204
50%.....	570
90%.....	720
95%.....	746
E.P.....	746
Res.....	97%
Res.....	3%

The impurities which developed during operation included crude oil brine, emulsions, water, iron,

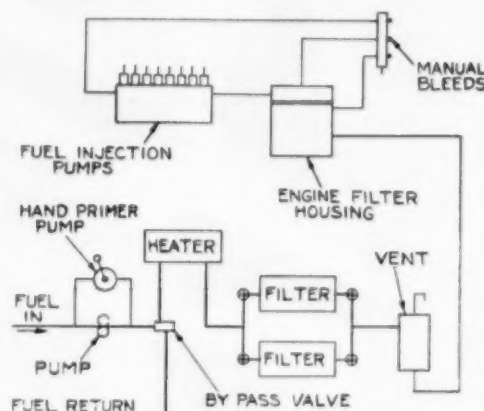
sodium, acids, ash, calcium, manganese and copper sulphate compounds. The first attempt at filtration was the design of a filtering system consisting of a settling tank, a treating tank containing conventional treating matter, and cleanable metal-edge type filters. This system handled approximately 30 gallons an hour and nearly 4% by volume of the oil was solids that would have to be removed from the oil.

While this installation was successful to a limited extent, it was not completely satisfactory for the following reasons: 1) Settling was ineffective at temperatures below 70°, the settling tank was too expensive to operate, and it did not effectively remove the crude oil brine emulsions present; 2) treating tanks were too expensive to install and too much shutdown time was required to replace treating materials; and 3) metal-edge filters clogged too rapidly because of the large quantity of impurities in the crude, thereby presenting difficult servicing problems.

Faced with these obstacles, the oil company approached Purolator Products, Inc., for a better

solution. Purolator decided that its convoluted impregnated cellulosic element would satisfactorily handle the impurities found in the crude and prevent them from wearing away nozzles and other components of the injection system. Purolator selected filter elements that would effectively remove impurities from the crude, down to two microns in size. These elements were located in the system in parallel groups so that several of them could be shut off separately from others in order to remove clogged elements and replace them without shutting down the operation.

This installation is shown in Fig. 1, which illustrates a typical installation for a 200-hp. engine, showing how each of the filters can be removed separately from the system. Each of the two filters in turn consists of two elements and each element contains 3,000 sq. in., resulting in a total of 12,000 sq. in. of filtering area available during flow through both passages. This is more than adequate to handle the 30 gallons an hour necessary to the operation. Some of the engines involved were of 400-hp. size and required four filters in parallel instead of the two filters shown in Fig. 1.



PIPING DIAGRAM
CRUDE OIL FUEL SYSTEM

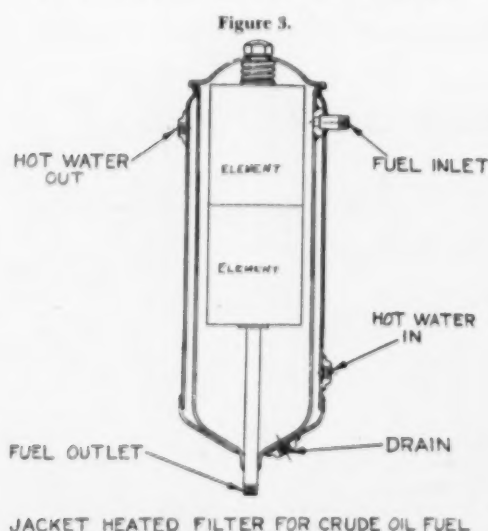
Figure 1.

Figure 2.

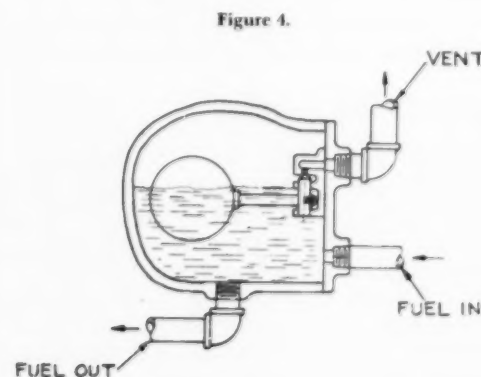


Fig. 2 illustrates the Purolator P-29 element, two of which are used in each filter. In order to reduce the viscosity of oil, especially under cold conditions, the filter was equipped with a heating jacket as shown in Fig. 3. This jacket is concentric with the filter elements and is supplied with water from the diesel engine cooling system. Under extreme cold temperature conditions, it is even possible to circulate steam in the heating jacket to afford an even better heating device.

Fig. 4 indicates a vent which was installed immediately following the filter in order to drive off undesirable vapors. As can be seen in the diagram, a conventional ball-type valve is used to open or close the vent. Referring again to Fig. 1, it is noted that the system was devised to by-pass unused fuel back into the reservoir before reaching the filter. This system proved to be entirely satisfactory and a surprisingly high life of 2,000 hours per cartridge was achieved. In addition to the efficiency of operation, approximately \$10,000 per installation was saved by the use of the improved Purolator system.

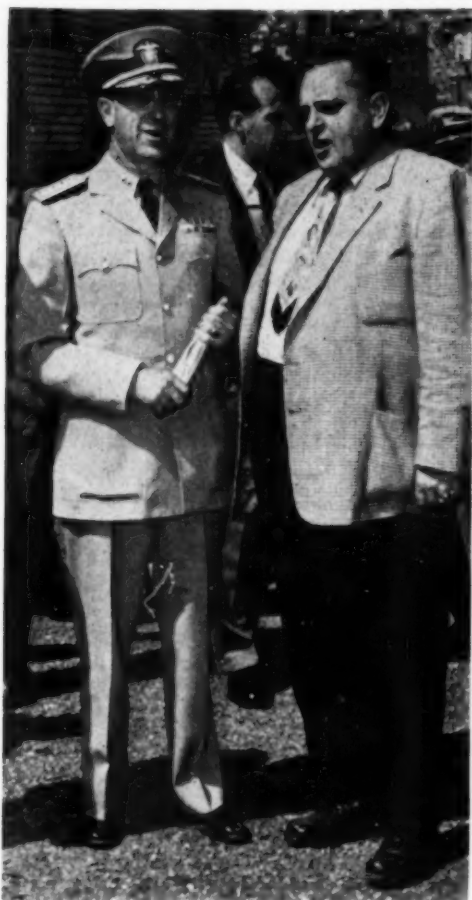


JACKET HEATED FILTER FOR CRUDE OIL FUEL



CRUDE OIL VAPOR VENT

Rear Admiral Leggett Tours Yards



Rear Admiral W. D. Leggett, head of the Navy's Bureau of Ships, is pictured above talking to our well-fed associate editor, Charles F. A. Mann, at the J. M. Martinac Shipbuilding Corp. yards, Tacoma, Wash. As the whole industry knows, Admiral Leggett has been vitally interested in the mine-sweeper program which DIESEL PROGRESS and Mr. Mann have covered so thoroughly in this issue. Admiral Leggett was making a tour of the yards building the minesweepers at the time.

Expansion, Promotions Announced

Expansion of facilities and preparations for the opening of new branches in Amarillo, Dallas and San Antonio, Texas, have resulted in several changes and promotions of personnel by Cummins Sales & Service, Inc. According to President Ken W. Davis, the changes are as follows: Abilene—E. H. Smith has been named service manager. Odessa—W. R. Bowman is new service manager. Farmington (N.M.)—J. A. Moseley is now sales and service engineer, working out of the Odessa shop. Fort Worth—J. P. Williams has been named service manager. Wichita Falls—Mike Duncan has been promoted to store and parts manager.

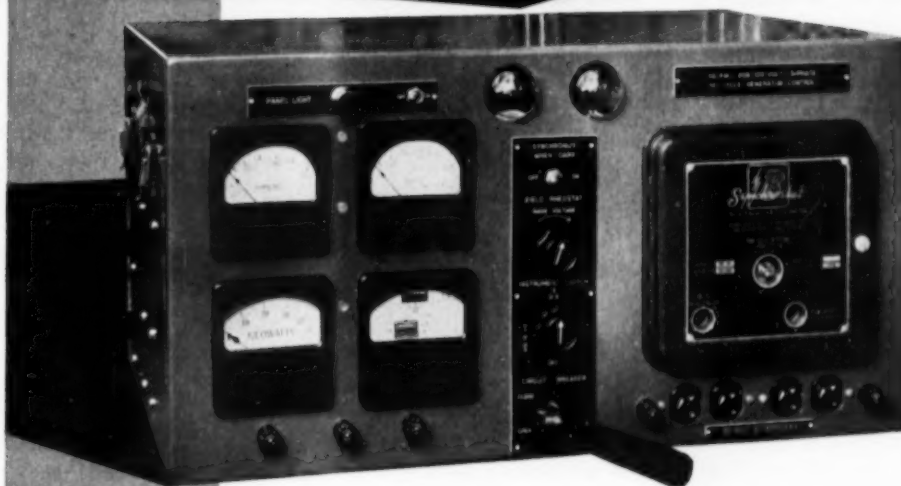
Nilsson Sails for Europe

K. H. Nilsson, who retired recently as New York branch manager of the National Supply Co.'s engine division at Springfield, Ohio, has sailed for Europe to visit his native Sweden. Despite his retirement, Mr. Nilsson will remain in business upon his return in September. While abroad he will visit Sweden, Norway, Denmark, England and the continent, making his headquarters in Stockholm.

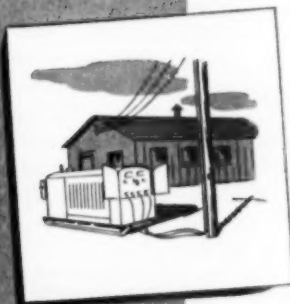
JULY 1954

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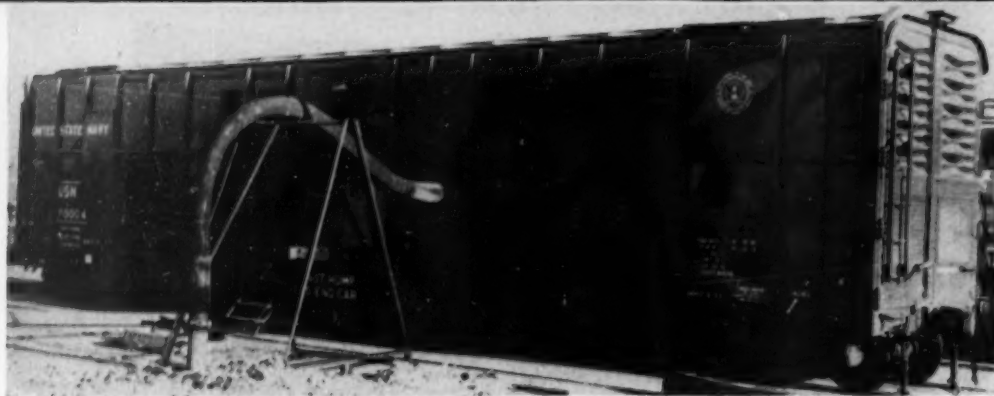
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A CIVIL DEFENSE APPLICATION



BUILDS LARGE MOBILE COMPRESSORS

A pair of heavy-duty air compressors capable of supplying a combined volume of 5000 cfm. at a pressure of 125 psi. have been put on wheels by Clark Bros. Co. of Olean, N. Y., to meet specifications of the Navy's Bureau of Yards and Docks. Clark's 138,000-pound mobile plant, complete with 500 hp. electric motors, switchboard, transformers and cooling and lubricating systems, has been fitted into a single 60-ft. railway boxcar. On the day the first unit was completed, two big stationary compressors at the Charleston Naval Shipyard broke down. The mobile plant, slated for a trial trip to the west coast, was diverted to South Carolina.

Arriving at the yards at 2:15 p.m., it was put into service at 2 p.m. the next day—less than 24 hours after arrival. The mobile compressors worked a regular 8-hour shift for the next 42 days while the damaged stationary units were being repaired.

The idea for the mobile units was born in 1951 when the Navy needed a large quantity of compressed air for a temporary project. Bureau engineers felt it wasteful to construct a compressor building and install stationary compressors, but they had no alternative. About the same time, the Navy faced the problem of recommissioning ships that had been in "mothballs," a process requiring a lot of compressed air that was either in short supply or unavailable. In both instances, a mobile compressor plant could have moved in to do the

job with minimum expenditures of time and money. And Navy experience indicated that other important services could be rendered by a high-volume, heavy-duty mobile compressor. During the war years, shipbuilding contracts to many private yards were delayed for lack of air. The Navy contemplates use of mobile compressors to get essential industrial plants into production faster and to keep air-powered tools operating.

To serve all these purposes, it was essential to have heavy-duty compressors because they might be called on to serve for months at a time. The 5000 cfm. size and 125 psi. pressure were specified because they are standard in shipyard service and lesser units would not meet the need. A few of the specifications to be met were these: 1) that all components be standard products to facilitate maintenance and repair; 2) that the car and its equipment in operation vibrate no more than 0.030 in. in any direction; 3) that it operate for long periods in any ambient temperature from -25°F. to plus 125°F. and under severe humidity conditions; 4) that it withstand shock equivalent to coupling the car fully equipped to a heavy stationary train at a speed of 10 mph.; 5) that the equipment be readily accessible for maintenance.

In meeting these requirements, Clark used two identical LCMA-4, 2-stage air compressors, each with capacity of 2500 cfm. This is basically the

company's regular 4-cylinder, 8-in. stroke, balanced opposed compressor. Normally, all four cylinders are horizontal, making the unit too long for the space available in the boxcar. The solution was a 4-cylinder unit with the two 20-in. low-stage cylinders vertical and the two 11½-in. high-stage cylinders horizontal. Each of the two compressors is driven by a specially compact 500-hp. synchronous motor mounted on the end of the crankshaft. A motor bearing is built into the compressor. These medium speed motors are easy to start across the line, limiting inrush to 300%. To facilitate starting and to regulate compressor output, all compressor cylinders are equipped with suction valve

unloaders which provide automatic 5-step unloading. Electric immersion heaters make it unnecessary to start a compressor cold.

Each compressor is self-sufficient, complete with its motor, air, water and lube oil systems, all mounted on structural steel skids so the entire unit can be pulled out of the car for major maintenance. Ports are provided in the side and top of the car to permit all normal maintenance.

Intercooler, aftercooler, oil cooler and water cooler all are built into a single unit with a bundle of finned tubes for each circuit. The air, water and oil in these tube bundles are cooled by air drawn through shutters, regulated by automatic thermostatic controls, in the end of the car. The plant can be operated indefinitely with all doors closed, motor-driven fans providing ample ventilation. The plant can use a power supply at either 4160 volts or 2400 volts, which increases its flexibility.

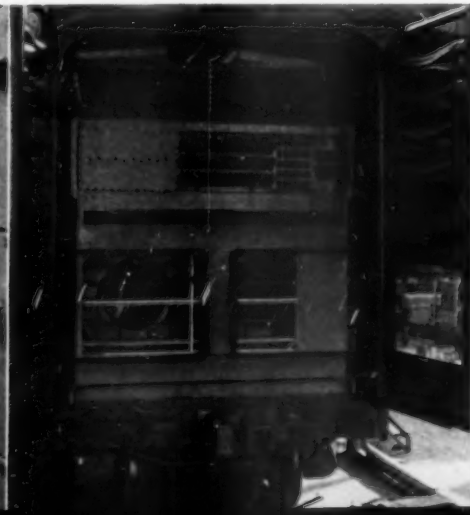
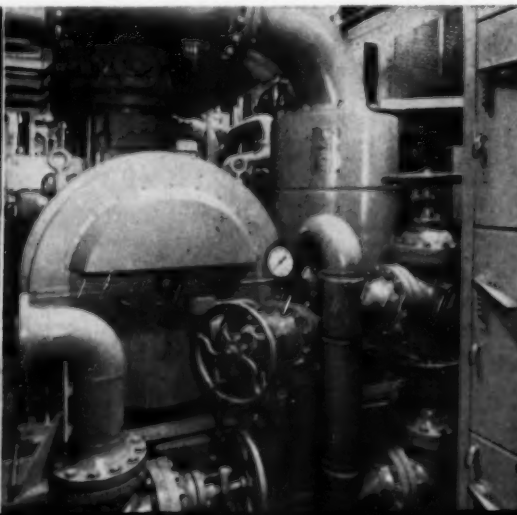
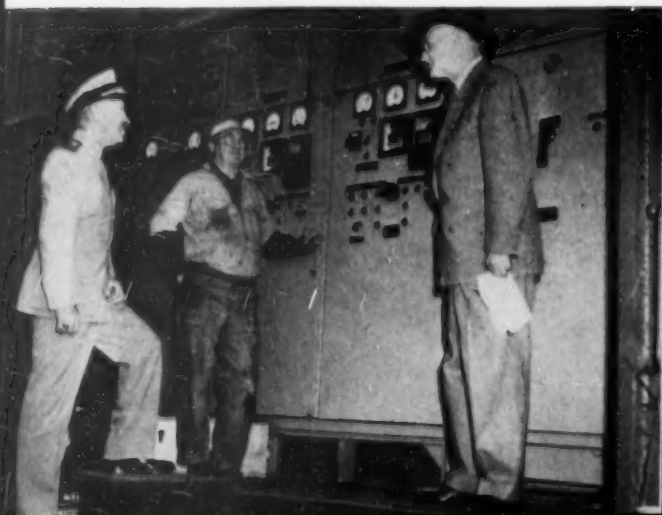
The car stows electric cable to tie in to the power supply and for grounding purposes. To give it a firm foundation for operation of the compressors, the ends of the car are clamped to the rails with four clamps and then built-in, screw-type jacks lift it off the springs, making the installation rigid and solid. Performance of the plant on its first emergency job assures the Navy of protection against air supply failure at any installation that can be reached by rail.

With car's end open, it is easily seen how the compressor fills available space. This view shows the compact cooling system which includes two motor-driven blowers and separate bundles of finned tubes for the intercooler, the aftercooler, compressor cooling water and lubricating oil. Thermostatically controlled shutters not yet installed.

The mobile plant is inspected while in service in the Charleston Naval Shipyard. Left to right: Commander J. K. Batchelor, assistant district public works officer, 6th Naval district; L. J. Young, engineer, Steam Electric; and John Brock, director, T & ED, DPWO, 6th Naval district.

This view inside the car shows one of the 4-cylinder, 2-stage Clark air compressors, each driven by a 500 hp. synchronous motor. This is the first time that compressors of this size and capacity have been put on wheels. It is evident from the photograph that there is no room to spare.

72



New Supercharging System

A supercharging system that enables internal combustion engines to double their power with no increase in size or weight has been patented by Ralph Miller, consulting engineer. The application of the Miller system means that in the foreseeable future, automobile and truck engines can be built



Ralph Miller

to operate on low grade, low octane gasoline with double the present day mileage-per-gallon. An engine using the Miller system develops more than twice the power within the same space and weight limits. For this reason, the invention is now being tested by the U. S. Naval Experimental Station at Annapolis, and a development contract has been granted to a licensee under the patent to build an engine suitable for submarines and surface craft.

The Miller supercharging system aroused wide interest in this country when it was applied to the eight-cylinder 2000 HP engines which pump oil through the newly completed Lakehead Pipe Line crossing the Straits of Mackinac between Superior, Wisconsin and Sarnia in Canada. The pumps on the Trans-Mountain Pipe Line between Edmonton and Vancouver, Canada, are also powered with oil and dual fuel engines built to incorporate Mr. Miller's invention. A United States citizen born in Denmark, Mr. Miller has been a prominent factor in the development of internal combustion engines here and in Europe for years.

Leadbetter Heads Burgess-Manning

Ralph L. Leadbetter of Dallas, Texas, has been elected president of Burgess-Manning Co., Libertyville, Ill., pioneer manufacturer of industrial noise abating equipment, according to Board Chairman Jackson Burgess. Mr. Leadbetter succeeds Willis L. Manning, president since the company was organized in 1944. Mr. Manning will retain his position as treasurer and a member of the board.

The new president had been in charge of the company's Dallas division since its formation in 1951 and had served as vice president since 1944. He and Mr. Manning were with the Acoustics Division of Burgess Battery Co. before organization of Burgess-Manning Co. The firm manufactures exhaust and air intake silencers, gas and air-line snubbers, sound-conditioned telephone booths and a 3-way functional ceiling that heats or cools radiantly and incorporates sound control. Principal offices are in Libertyville, where railroad and other industrial silencers are manufactured.

Swedish High-Speed Diesels

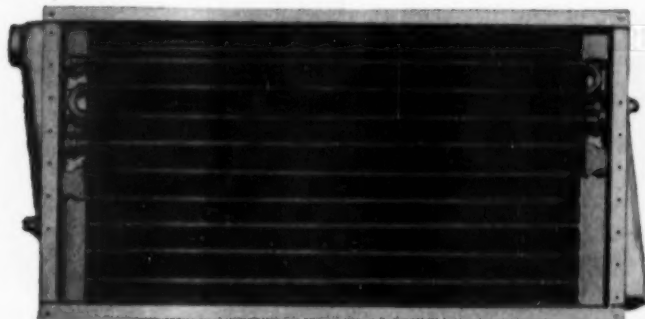
The widely known Swedish Bolinder-Munktell line of high-speed diesel engines is now being merchandised in Texas, Louisiana, Oklahoma and Arkansas by the American Bolinder-Munktell Co., 7118 Navigation Blvd., Houston 11, Texas, where a stock of engines and parts is currently available.

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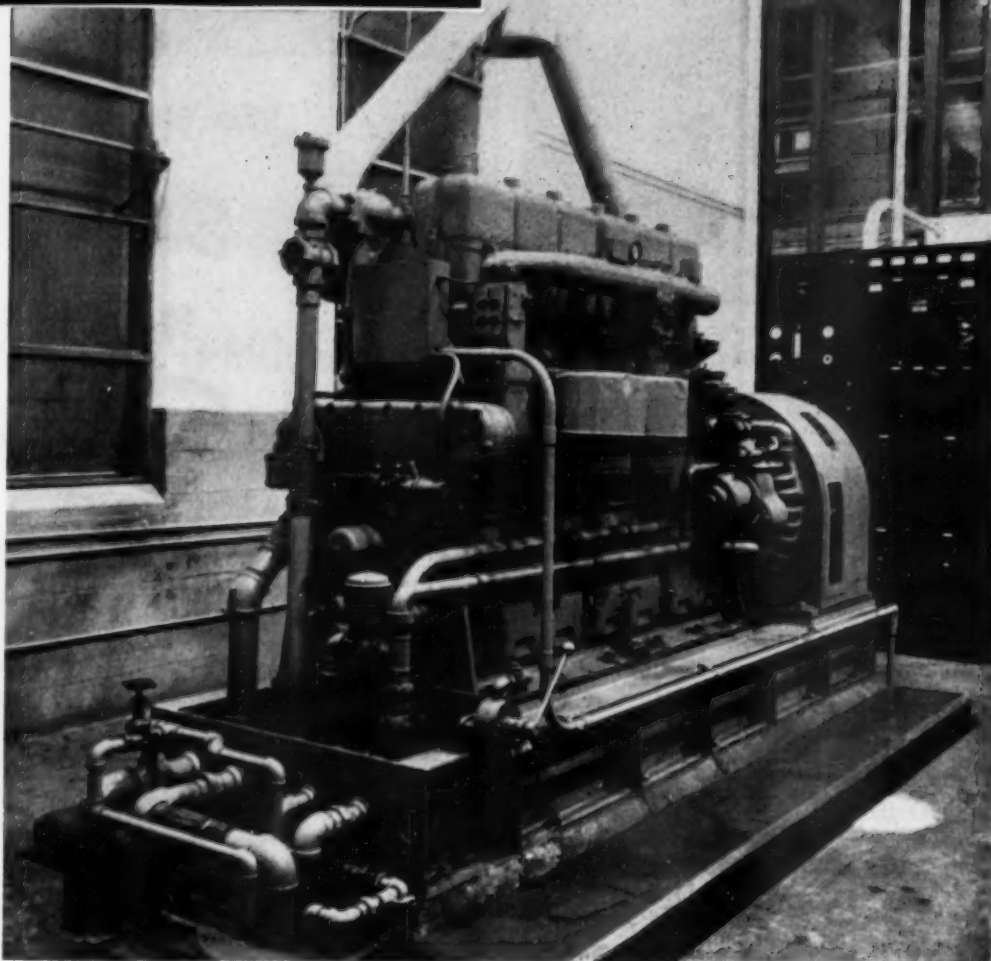
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A CIVIL DEFENSE INSTALLATION

EMERGENCY power requirements, along with expansion of the power distribution system, presented a growing problem in the economical operations and safety of the aircraft plant taken over by North American Aviation, Inc., in Columbus, Ohio, in 1950 for production of jet aircraft parts. The problem resulted from a growth in production far beyond the original capacity of the plant. The increased man-hours of work on jet air frames up to the present 17,000 employees working "round the clock," and the expansion of the plant necessitated first a careful re-distribution of electric power. When this was completed recently the normal power consumption exceeded the peak loads of the plant during the war years when it was used in the production of piston-engine type aircraft.

Conversion to a fully adequate system of power distribution and stand-by power were accomplished over the past two years under the guidance of V. R. Little, superintendent of maintenance, and Frank A. Mason, plant electrical engineer. The magnitude of stand-by power needs is indicated by the plant's power demand of 11,500 kw., which is brought into the plant at 40,000 volts with multiple tie-ins to power supplies of nearby cities. Since this did not prevent power failures, stand-by power was necessary to maintain a safe level of illumination, keep plant communications working, supply the fire alarm system and stationary fire equipment with power, and provide other types of protection not common in industrial plants. One of these is outside floodlighting and another is drainage of heavy rain fall or water that would collect on the floors during fire fighting by operation of motor-powered sump pumps.



Emergency power for the Columbus, Ohio plant of North American Aviation, Inc. is provided by this heavy-duty 295 bhp. Superior gas engine driving a 200 kw. Elliott generator.

GENERATOR SET GUARDS AIRCRAFT PLANT

**When This Vital Aircraft Plant Needed A
Guaranteed Source of Emergency Power,
They Installed A Superior Engine
Driving A 200-Kw. Generator**

Solution of the stand-by power problem was based on a careful study of essential functions. For example, calculations indicated that power for one light in 25 would be required for emergency illumination of the acres of factory floor and the offices. When all of the emergency power requirements were totaled it was concluded that a 200 kw. generator would adequately protect the plant. For power to drive the generator, a heavy-duty Superior spark ignited gas engine rated 295 bhp. at 900 rpm. was specified. Top rating of 325 hp. can be obtained at 1000 rpm. The engine, a model 6G-510 widely used in oil well drilling service, was supplied by The National Supply Company's Engine Division in Springfield, Ohio, and the generator by Elliott Company. In addition to the main stand-by unit are two other small stand-by generators. One of 40 kw. capacity is in the main warehouse and another of 15 kw. capacity is used in the company-operated radio control tower. These may be operated independently if necessary.

Several features of automatic operation make the provisions of emergency power practically fool-proof regardless of storms or other causes of power utility line or plant break downs. Automatic starting of stand-by power units by air, gas engine, and battery power are available. Switchgear includes an electrically operated breaker to connect the emergency power source to the common load bus, and a similar breaker for connecting "normal power" to this bus. An auxiliary panel is equipped with engine alarm and shut-down control as well as automatic emergency power control. An "emergency control" switch provides for either automatic load pick-up or manual starting. Under automatic control the engine is started by an air motor if the voltage of the normal power supply drops below a predetermined value. This will be preceded by a bell alarm and a pilot light indication "normal power off." When the stand-by generator voltage reaches proper value the normal power breaker opens and the emergency power breaker closes.

These automatic operations will take place in the reverse order when the normal power source returns to its proper value. To provide for regular testing of the equipment, a "test control" switch is operated to simulate a failure of normal power.

The automatic operations follow in the same order, and in the reverse order when the switch is turned off. Further protection of the engine against defective oil pressure, excessive water temperature and speed, is provided by means of an alarm and shut-down control on the auxiliary panel. As the engine starts automatically and lubricating oil pressure increases, automatic energization of these controls is indicated by a pilot light. Automatic stopping is accompanied by automatic reversal of this sequence. Storage batteries energize the alarm panel when the stand-by engine stops and there is no other power available. All pilot lights and alarms can be tested at any time either while the engine is idle or running.

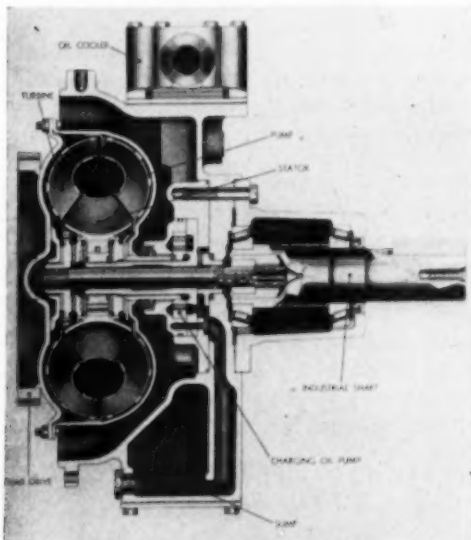
Torque Converters for Lower Power Engines



Checking simplified design of new, self-contained Allison 200 series Torqmatic converter are J. A. Lane (left), transmission sales manager, and K. H. Hoffman, manager of transmission operations for the Allison Division of General Motors Corp.

Torque converters meeting the requirements of heavy-duty operation now are available for application in the lower power range, through the development of a new series of Allison Torqmatic drives. The new converters, designated as the TC-200 and TC-300 series, can be used with either gasoline or diesel engines in the 40 to 150 hp. range. "This new series provides the first completely integrated converters available for lower power application which have been specifically designed for the industrial field," according to J. A. Lane, sales manager, transmissions operations of the Allison Division, General Motors Corp. "They have a wide range of application covering road rollers, cranes, shovels, and loaders, tractors and ditchers. Because the converter has been designed as a standard package to blanket this field, this new series can be offered within the price range of the automotive type. In addition, many features such as the combination of hydraulic torque multiplication with fluid coupling are standard in the converter at no extra cost."

The self-contained unit is designed for simplified flexible installation because integral with the converter are the oil system, charging oil pump, oil



This cross-section shows new "three element" Allison torque converter available with either industrial shaft or automotive flange.

cooler, oil sump and gear drive. Installation can be made on any SAE standard power take-off flywheel. However, available with the basic converter are a wide variety of options including front disconnect clutches and adapters, rear disconnect clutch adapters, automotive type flanges, industrial shafts and governor drives.

Addition of the new series enables complete coverage of the 40 to 400 hp. range with Allison Torqmatic drives for both gasoline and diesel engines. They cushion drive-line shock, providing longer life for drive lines, cables, tires and other equipment subject to damage through sudden heavy loading. There is no gearshift guess and a constant engine-load balance is maintained.

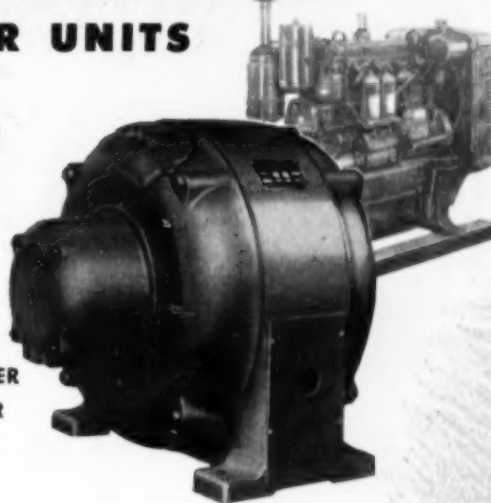
Leakproof Hose Coupling Booklet

A quick connect-disconnect hose coupling for water, oil, steam, gas and chemical lines which provides freedom from leakage is described in a new bulletin published by Titeflex, Inc., Springfield, Mass. The 16-page booklet, titled "Titeflex Quick-Seal Coupling," points out how the simple construction of the coupling provides a sealing action which makes the coupling tighter as internal pressure increases and describes the full swiveling action that prevents twisting and kinking of the hose. Also described are single- and double-check valve modifications of the coupling and coupling accessories. Copies of the publication are available by writing to Industrial Sales, Titeflex, Inc.

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PALMER, the originators of Self-Regulated Alternators, was the first to bring industry the economy of Portable Power...through self-regulation.

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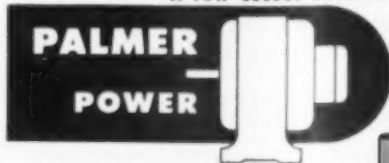
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Nickles Expansion Program

The Nickles Machine Corp., Ponca City, Okla., recently completed a major expansion in tripling its floor space, and has started to add another 4000 square feet. Founded in 1930 by C. A. Nickles as Nickles Machine, Inc., the company expanded steadily as a manufacturer of replacement parts and repair service on stationary diesels, gas engine compressors and pumping equipment in the oil, gas and chemical fields. A considerable part of the firm's work recently has been done for South American installations.

R. C. Nickles, son of the founder-president, is gen-



Part of Nickles Machine Corp. expansion program is pictured here. The Oklahoma firm was founded in 1930.

eral manager. Sales representatives are located in Houston and Odessa.

Florida Diesel News

By Ed Dennis

FROM General Engine & Equipment Co. at Tampa a model 4-51 General Motors diesel on the yacht *Java*. Paragon 1.1:1 reduction gears. Durant Inc. of Clearwater are the owners.

THE LATEST addition to the Bee Line ferry fleet, the *Hillsborough*, is giving a good account of itself as a money maker. Powered with two 16-cylinder model 278-A General Motors diesels, it was smooth sailing across Tampa Bay.

GIBBS CORP. at Jacksonville packaged the fishing trawler *Calumet* with a Caterpillar D-13000 and the *Phoenix-Shaw* with a model D-337. Both have Snow Nabstedt reduction gears and Twin Disc power take-off. Both are fishing the Ft. Myers area.

POWERED BY DEUTZ diesel engines are the two new Menhaden fishing boats at the Fish Meal Co.'s dock. One was built by Arnold V. Walker Shipyard, Moss Point, Miss., and the other by a Texas firm. Both have twin 6-cylinder Deutz diesel engines.

AT PENSACOLA, the Bahia-Mar shipyard received a 190-hp. Murphy diesel with a Twin Disc clutch from Kennedy-Morris Co. for installation in the new 75-ft. trawler of the Walpace Co.

FROM Florida Georgia Tractor Co. at Miami, the De Fonce Construction Co. received a TD 9 tractor with a 50-hp. International Harvester diesel engine for general construction work.

AT PENSACOLA the Turner Supply Co. received a 60-kw. General Motors generating plant with the series 71 diesel from Kennedy Marine Engine Co. which also supplied the GM 6-110 diesel for the *Biloxi Adventurer*.

THE ORLANDO livestock farm at Orlando received three rubber-tired D6 Caterpillar scrapers to be used in farm work from the Rozier Equipment Co., Tampa.

AT ST. AUGUSTINE the 500th dieselized fishing trawler *Goodwin* was launched June 7 in the shipyard of the Diesel Engine Sales, Inc.

THE WEST INDIES freighter *Star of Honduras* was repowered and converted from an ex-Navy LCI at Gibbs in Jacksonville with two model D 17000 Caterpillar diesel engines.

THE CITY OF SEBRING'S latest addition to its municipal power plant was a Nordberg diesel rated at 2156 kva. A Westinghouse generator, Elliott turbo blower, Woodward governor and Manzel lubricators make this installation a complete job.

PURCHASED BY Paul B. Dickman Land Reclaiming Co. at Ruskin for use in its new dredge: a General Motors model 6-110 diesel plus a GM 3-71 diesel generating set.

FLORIDA DIESEL Engine Sales at Jacksonville supplied the GM 6-110 diesel rated at 205 hp. for the *Trojan* launched at St. Augustine by Modern Trawlers. GM power take-off and 4.5:1 reduction gears.

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TREMENDOUS SHELF LIFE

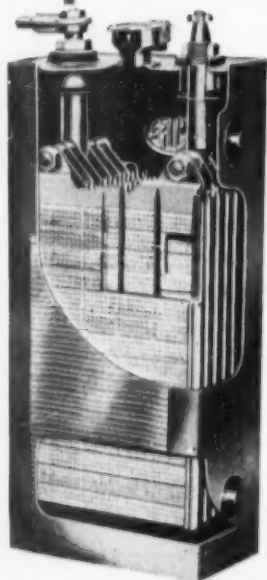
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At a push of a button, in heat or cold a battery must produce guaranteed power without the loss of a fraction of a second. Your Diesel Engine is there with the horsepower but it is no good unless it is running. NIFE Batteries have started big engines as many as 170 times without a recharge and have performed after a year of shelf standing without even a trickle charge.

They save time, labor and money over many years of guaranteed service. With NIFE Nickel Cadmium Batteries, you can send your Diesel out and be sure the engine can be restarted.

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Our company started producing the NIFE battery type SIPO—with sintered plates—since World War II and recommend their use where high discharge at low temperatures are the factor. We will be glad to deliver sintered plate or pocket plate type batteries for every use in any size and quantity desired.



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Write or wire for technical information.

Eaton Acquires Dynamatic Corp.

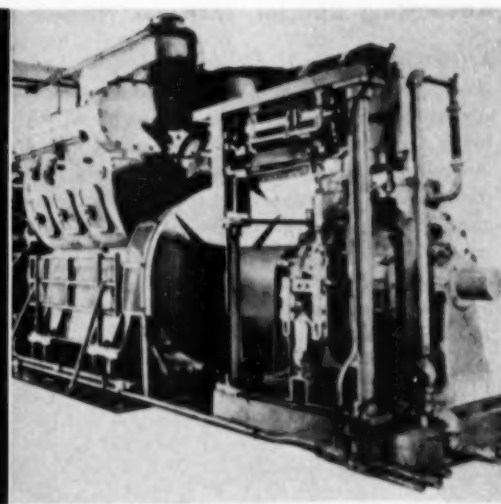
Beginning this year, the Dynamatic Corp. became a division of the Eaton Manufacturing Co. Dynamatic was originally incorporated in 1932. Manufacturing facilities and operations, concentrated within an enclosed area of 150,000 square feet, will remain unchanged. Production facilities cover a wide range of equipment, all basically functioning on the magnetic eddy-current principle of transmitting or absorbing torque.

A few Dynamatic products are Ajusto-Spedes, an integral combination of ac. induction motor and eddy-current coupling; separately mounted air and liquid cooled couplings and brakes; and absorption, motoring and universal dynamometers. In the diesel engine field, many successful applications of Dynamatic equipment have been made, such as oil field clutches and brakes, marine clutches, shovel clutches, fan drives and testing dynamometers.

Winch drive problems have been solved by using Dynamatic liquid cooled eddy-current couplings on trawlers of a large eastern fishing concern. When new high-powered diesel engines were installed aboard two ships, the existing winch drives were to be replaced by drives that would absorb shock without damage to cables and nets and also provide a smooth, non-grabbing takeup of the cable. Couplings rated 125 hp. at 400 rpm. were directly coupled to a power take-off shaft on the forward end of the trawler diesel engine. The eddy-current coupling output shaft was connected to a gear box to drive the winch. Coupling excitation was ob-



Dynamatic coupling connected to the diesel engine with only the top of the drive showing above the floor plates.



Dynamatic dynamometer shown in position for testing a diesel engine. This is a model 3020.

tained from the ship's dc. supply to control the speed and torque supplied to the winch drum. A Dynamatic dynamometer in position for testing a diesel engine is pictured in an accompanying photograph. This is a model 3020 water-cooled absorption dynamometer, having a maximum rating of 1500 hp. at 800 to 3000 rpm. The power output of the engine may be accurately measured at all points within its rating by simply varying the small amount of excitation required by the dynamometer field coils. The dynamometer consists basically of an eddy-current brake supported by trunnion bearings and mounted in pedestals. The free rocking

housing or casing is restrained from rotating by a weighing device that measures the torque developed. Ample provisions are provided for liquid, usually water, to carry away the rejected power in the form of heat. New diesel engines and design changes may, therefore, be accurately checked for actual engine performance or improvement. Eddy-current adjustable speed devices are, in most cases, adaptable to problems on rotating equipment.

For further information, write to DIESEL PROGRESS, File No. 115, Box 8458, Cole Station, Los Angeles 46, Calif. Ask for Bulletin No. GB-1.



On the new USS ENDURANCE...

Westinghouse Pneumatic Control regulates diesel engines

•It's always "touch and go" on the Navy's new minesweeper, the USS Endurance. Just a touch of the lever of a Westinghouse Control Valve and off she goes at any speed the pilot selects. The valve automatically maintains the desired speed. Reliable Pneumatic Controls, supplied by Westinghouse Air Brake Co., operate the Packard diesel engines that power this sleek new ship.

Westinghouse Pneumatic Control is being used to give smooth, fast-acting control of engines on pleasure craft, tugs, and work boats. Write for specific information.

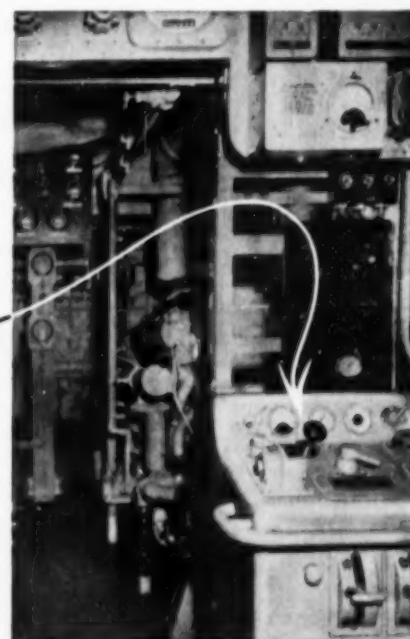
Westinghouse Air Brake COMPANY

INDUSTRIAL PRODUCTS DIVISION



WILMERDING, PENNSYLVANIA

Manufacturers of air compressors, pneumatic cylinders, actuators, air control devices of all kinds, engineered pneumatic control systems and front end loaders.



Westinghouse Control Valve in the engine room and in the pilothouse assure split-second operation, good maneuverability, accurate speed control.

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entitled, "AT THIS MOMENT"—showing a vivid story of modern railroad progress. Length 26 minutes, on 16 mm color sound film. For use of film write: United World Films, Inc., 1445 Park Ave., New York or Association Films, Inc., 347 Madison Ave., New York.

Factory Branch: Emeryville, Calif. Distributors throughout the United States. See your Classified Directory. Distributed in Canada by: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

Advertising Director, Manager Named

Appointment of Joe H. Serkowich, "industrial advertising man of the year" in 1953, as director of advertising and publicity for Westinghouse Air Brake Co., Pittsburgh, Pa., has been announced by Edward O. Boshell, chairman and president of the company. He formerly was advertising manager of LeTourneau-Westinghouse Co., a subsidiary of Westinghouse Air Brake. In his newly created position, Mr. Serkowich will coordinate the advertising programs, sales promotion and public relations of all the company's divisions.

Lloyd A. Rager, formerly assistant advertising manager and more recently sales promotion manager

for LeTourneau-Westinghouse, has been named to succeed Mr. Serkowich, according to John W. Schoen, vice president and general sales manager. Mr. Rager is a veteran employee of the LeTourneau-Westinghouse plant at Peoria, Ill.

'When Power Fails'

The story of how emergency power units can prevent loss of time, production and lives is outlined in a new 8-page booklet, "When Power Fails," available from Caterpillar dealers or the Caterpillar Tractor Co., Peoria, Ill. The 2-color booklet, Form D432, contains pictures and data on stand-by units operating at hospitals, plants, television stations and the like.



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up to 600° F.

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so many advantages as*

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- Cyclan's resilience exceeds that of cast iron.
- Cyclan retains the bearing characteristics of cast iron.
- Cyclan has extra high impact value for resisting shock.
- Cyclan piston rings are especially durable in super-charged engines.
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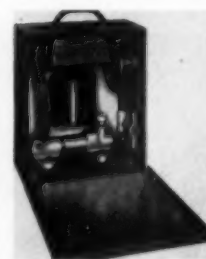
Diesel Engine Catalog Off the Press

"Indispensable!" That describes the big, all-new DIESEL ENGINE CATALOG and what this giant reference book means to a progressive, robust diesel industry. Volume 19, profusely illustrated and containing more than 400 pages, is just off the press and ready for mailing. Handsomely bound in serviceable white leatherette, the catalog is brand new from cover to cover. Only its price, \$10 a copy postpaid, remains the same.

DIESEL ENGINE CATALOG is a "must" for design and operating engineers as well as buyers; it is invaluable to instructors and students alike. This completely revised book reports fully on changes in engine ratings, speeds and sizes. Its accessory section contains new models and tables. Technical descriptions and specifications are presented in easy-to-read fashion.

Engine companies, field representatives, industrial salesmen, oil companies, consulting engineering firms, railroad purchasing and engineering offices, government procurement offices—everyone with an interest in the diesel industry finds DIESEL ENGINE CATALOG a useful guide. To be sure of YOUR copy of volume 19, send your check (\$10 plus sales tax if for delivery in California) to DIESEL PROGRESS, Cole Station, Los Angeles 46, Calif. Or, if you wish to be billed, send a company form order. But do it today—this edition is limited to 10,000 copies and orders are now being filled.

Portable Nozzle Maintenance Outfit



A new portable nozzle cleaning and testing outfit being made available by American Bosch Corp. of Springfield, Mass., is of special interest to those responsible for diesel engine maintenance. The outfit consists of a compact metal carrying case containing a nozzle test stand and cleaning kit. The nozzle test incorporates a fuel injection pump to make sure the nozzles being tested are subjected to approximately similar hydraulic conditions as are encountered on an engine. A filter is included to protect the nozzles from being injured by dirt. This portable maintenance outfit helps detect conditions which may cause excessive smoke, increased fuel consumption and loss of power.

GM Executive Elected Trustee

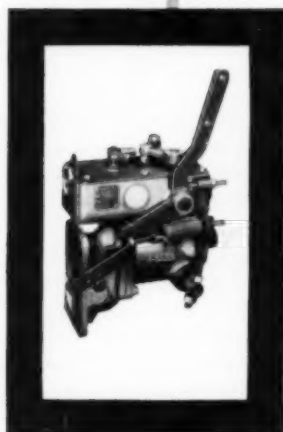


N. C. Dezendorf, General Motors Corp. executive from Hinsdale, Ill., has been elected to the board of trustees of Beloit College, Beloit, Wis. His election was announced by Holman D. Pettibone, board chairman, and Harold S. Wood, acting president of the college. Mr. Dezendorf has been associated with GM since 1922. He is now a vice president of the corporation and general manager of the Electro-Motive Division.

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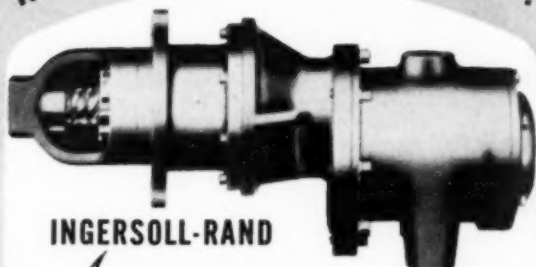
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Ribbon units are available in diameters from 1/2" to 6" in any required length with filtration rated at 40 microns (.0016").

Our engineering department will be glad to advise on new installations or to furnish replacement units in a variety of sizes. Write us for details.

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Gulf Coast Diesel News

By Michael T. Pate

TODD SHIPYARD, Galveston, Texas, has bought through Mustang Tractor & Equipment Co., Houston, a model D 13000 Caterpillar industrial unit which is to be used to repower a 25-ton Orton traveling crane. The diesel is rated at 151 hp. continuous output at 1000 rpm.

GULF OIL CO., Houston, has bought through Stewart & Stevenson Services, Inc., two General Motors series 71, model 4087, port and starboard diesel units to power a 35-ft. crew boat for offshore operations. The 110-hp. diesels will be mounted on their sides and inclined for propeller shaft drive,

which will be through 1½:1 reduction and reversing gears.

CLEGG & HUNT Drilling Co., Houston, has bought through Houston Engine & Pump Co. a model 24, 6-cylinder Murphy diesel developing 185 hp. at 1200 rpm. The engine will be used to furnish utility power and will drive a 15-kw. generating set, a 25-kw. generating set, 2 3-in. centrifugal pumps and an air compressor on one of the company's oilwell drilling rigs.

INDUSTRIAL SUPPLY CO., El Paso, Texas, has bought through Buda Engine & Equipment Co., Dallas, a Buda diesel, model 8DAS 1125, rated at 240 hp., which will be used in an irrigation project at Taos, driving a low-head centrifugal pump.

MARINE CONSTRUCTION CO., Patterson, La., has bought through Stewart & Stevenson Services, Inc., Houston, two General Motors diesel marine propulsion units, consisting of a series 71, model 6071A engine and a series 71, model 6072A diesel, each equipped with a 1½:1 hydraulic reversing and reducing gear. The diesels will power a 38-ft. crew boat with a total of 330 hp.

W. N. WALKER TRUCK Co., Hobbs, N. M., has bought through Waukesha Sales & Service, Houston, a model 135DKBS diesel developing 185 hp. at 2800 rpm., which will be used to repower a Mack truck.

RALPH BOLLINGER, Sealy, Texas, has bought through Mustang Tractor & Equipment Co., Houston, a Caterpillar diesel model D337, developing 170 hp. at 1600 rpm., which he will use for deep well irrigation service.

C. G. GLASSCOCK Drilling Co., Corpus Christi, Texas, has obtained four General Motors series 71, model 24103 quad-6 diesel propulsion units, which will power a drilling rig. The company also purchased four Stewart & Stevenson model 12GD150 ac. generating sets, each powered by a General Motors series 71, model 12103 diesel.

WESTERN SUPPLY CO., El Paso, has bought from Buda Engine & Equipment Co., Dallas, a Buda diesel, model DA844, developing 173 hp., which will be used in irrigation service.

R. L. SHIBLEY and J. D. Weich, Houston, have secured from Stewart & Stevenson Services, Inc., two General Motors series 110, model 62200, RA and LA, each equipped with 3.75:1 hydraulic reduction and reversing gears, to power a twin-screw 140-ft. hull to be used for seismographic work in Louisiana waters. They will develop 205 hp. each.

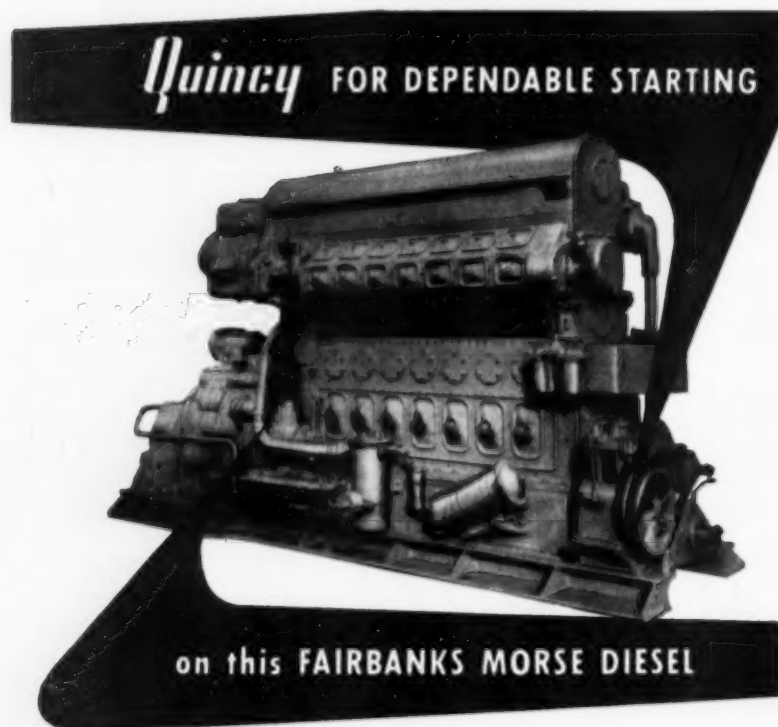
OILWELL SUPPLY Co., Houston, has bought from Mustang Tractor & Equipment Co. a Caterpillar D13000 diesel which will be installed on a new oilwell drilling rig being built for Brewster-Bartle Drilling Co., Houston. The diesel, developing 151 hp. at 1000 rpm., will furnish auxiliary power.

H. BOUDREAU & SONS, Sunset, La., have bought through Waukesha Sales & Services, Houston, two model 135DKB Waukesha diesels which they will use to repower two of their International trucks. The units will develop 147 hp. at 2800 rpm.

CRAWFORD PACKING CO., Palacios, Texas, has bought two General Motors series 71, model 6071A, 165-hp. diesel marine propulsion units, each equipped with 4.5:1 reversing and reduction gears.

ZACH BROOKS DRILLING CO., El Dorado, Ark., has bought through Waukesha Sales & Services, Houston, three model 6-LRDU Waukesha diesels, each developing 250 hp. at 950 rpm., which will be used to power a new drilling rig being fabricated for use in the Williston basin.

JOE WEINGARTEN, Houston, has had Waukesha Sales & Services, Houston, install a 10-kw. Waukesha model 180 DLC generator set in the yacht *J. W. Special* to provide for lighting.



Fairbanks Morse & Co. selected a Quincy Compressor to supply compressed air for starting this new apposed piston diesel. Like other leading diesel engine manufacturers, Fairbanks Morse used a Quincy because it gives long life and trouble-free service.

Specify a Quincy Compressor for your next diesel starting job. Compact, rugged Quincy Compressors will give you a dependable air supply.



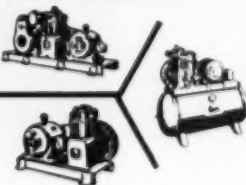
There's a Quincy Compressor for every job. Let us help you select the right model from a variety of mountings and sizes from 1 to 90 C.F.M.

Write Dept. K-38, Quincy Compressor Co., Quincy, Illinois, for catalog on Quincy Compressors for diesel starting.

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DIESEL ENGINE CATALOG

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All smart diesel engine salesmen carry this book around in their car. When they run into some new competition with which they are not too familiar, the DIESEL ENGINE CATALOG gives them full, accurate information when they need it most.

The consulting engineer keeps this book in his reference file. It immediately gives him all data on diesel engines coming within a given horsepower range, speed range and weight range.

People who sell, people who buy, people who use diesel engines need this new, fully illustrated, up-to-the-minute volume. It has been completely revised and expanded. Orders are now being accepted for this latest edition. Price \$10.00 prepaid.

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- ✓ 100% Water Removal! ✓ Traps Dirt and Dust!
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The new FRAM Water Separator & Fuel Filter is a double-action filter for complete injection system protection—

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Save the cost of replacing expensive injectors! Guard your diesels for longer life . . . less wear . . . fewer repairs—with the new FRAM Water Separator & Fuel Filter! For specific installation information write: FRAM CORPORATION, Providence 16, R. I. Fram Canada Ltd., Stratford, Ont.

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Diesels already equipped with FRAM Fuel Filter need only the Water Separator Filter and a new FRAM Coalescer Cartridge for 100% water removal!

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OIL • AIR • FUEL • WATER
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Engineering, Research Head Named



G. E. Burks

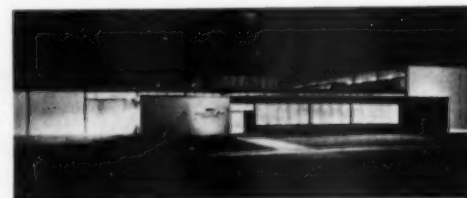
G. E. Burks, director of engineering, has been appointed director of engineering and research for Caterpillar Tractor Co., it is announced by President H. S. Eberhard. In his new position Mr. Burks will administer and coordinate all the engineering and research activities of the company, one of the functions previously performed by Mr. Eberhard. Mr. Burks was employed 25 years ago by the Western Harvester Co., then

a Caterpillar subsidiary. He joined the Caterpillar engineering staff at San Leandro, Calif., a year later and was transferred to Peoria, Ill., in 1938 as assistant chief engineer in charge of engine design. He was named chief engineer in 1942 and was appointed director of engineering in 1953.

Hercules Opens Expanded Branch

Hercules Motors Corp. has opened a new and expanded Los Angeles branch at 2336 S. Garfield Ave. in the heart of the industrial area. Facilities include a large salesroom, modern offices, a complete parts department and a fully equipped machine shop with truck and railroad loading docks. William Brumback heads the new branch.

Trane Dedicates Research Laboratory



Trane's new research and testing laboratories.

An expanded research program looking as far ahead as a decade is being mapped by the Trane Co. with dedication of its new research and testing laboratory at La Crosse, Wis.—a "house of weather magic" that increases the company's experimental and product development facilities threefold. Intensive studies already outlined range from basic flow studies on varying types of coils to correlation of factors affecting condensing and evaporating coefficients of refrigerants; from coil performance under severe frosting conditions to their performance at extremely high temperatures; and a number of other projects.


It also appears likely that the laboratory will figure significantly in helping to harness the atom for peacetime power. A report by President Eisenhower's top military adviser on atomic energy, who spoke at a dedication preview, pointed to the scope of the "new frontiers" in the path of the few laboratories in the country such as the new Trane laboratory devoted to heat exchange problems, including those essential to atomic power. "Among these," said Robert LeBaron, assistant to the Secretary of Defense, "are atomic energy, jet aircraft, guided missiles, space travel, electronics, radar, low temperature and many others." In all of these there is the common denominator of heat transfer: how to handle the heat of the atom, how to dissipate heat in high speed air flight, how to take the heat out of the interior of guided missiles, how to handle the heat problem in space travel.

Pursuing such studies, the laboratory tests radar tube coolers, for example, under conditions they might face in an Arctic plane-spotting station. A section of the cold room in the Trane laboratory is capable of creating 65-degree-below-zero cold.

Also under way is a long-range program designed to lick problems of frost formation on cooling coils. How different kinds and depths of frost coverings affect cooling coil heat transfer is being studied.

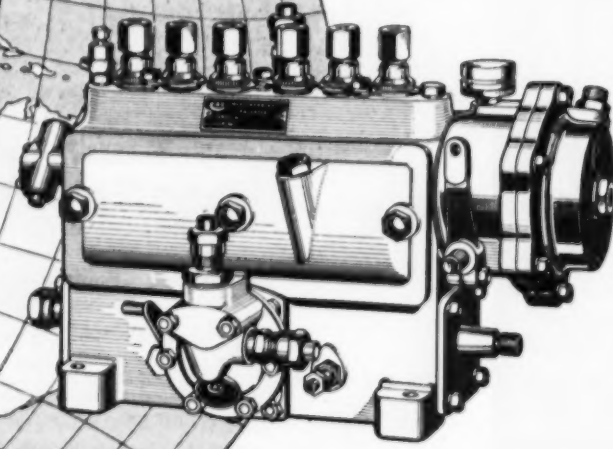
On display during the dedication were two railroad freight cars equipped with Trane mechanical refrigeration that can maintain sub-zero temperatures. One of the cars was owned by the Santa Fe Railroad, with whom Trane pioneered in the development of mechanical refrigeration for "reefers" in the early '40s. The other reefer was owned by Pacific Fruit Express.

ITS HERE! JUST OFF THE PRESS! Bigger, better, completely revised, rewritten and brought up to date. It's Volume 19 of DIESEL ENGINE CATALOG, now ready for mailing. Advance mail orders are now being filled for this giant reference book with its all-new, profusely illustrated sections. More than 400 pages. Orders are now being accepted for this limited edition, which costs \$10 postpaid plus California sales tax where applicable. Send checks or company form orders to DIESEL PROGRESS, Cole Station, Los Angeles 46, Calif.




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Fuel Injection and Electrical Equipment

New Massey Type E Governor

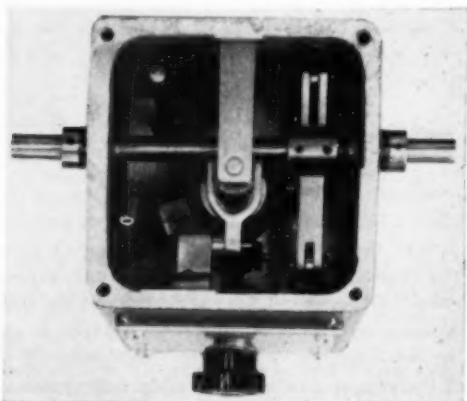


New Massey Type E hydraulic isochronous governor.

The Massey Machine Co., Watertown, N. Y., has introduced an extension of its line of hydraulic isochronous governors to include the small engine field. The new Type E governor uses the same proportioner principles as the Massey Type HP hydraulic isochronous governor in which compensation acts directly and hydraulically on the pilot weight system, resulting in simple construction and stability against overshoot, surge, hunt and jiggle.

The Type E governor is only 4 in. square and 7 $\frac{1}{2}$ in. high. It is offered in three models: dial type, dial type with synchronizing motor, and lever control type. Because the three models are interchangeable, the engine builder can standardize on one mounting, drive and linkage, regardless of whether the engine drives a pump, compressor, generator or marine propeller.

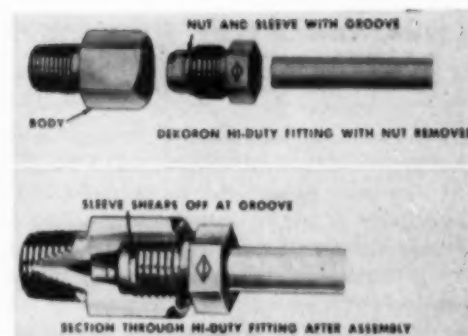
Work capacity of the governor is sufficient to handle 2 block type pumps of up to 8 cylinders each; up to 16 Bosch APFIC pumps; up to 8 Bosch APFID pumps; and up to 4 2-in. or 2 3-in. carburetors. Adaption bases are available so that the Type E will interchange on mounting and drive with most other hydraulic and centrifugal governors. All dimensions and other details are given in a catalog, No. E-54, which may be obtained by writing the Massey Machine Co.



Type E governor with cover removed illustrates its simplicity.

Leakproof Tube Fittings

A new line of leakproof tube fittings that withstand severe vibration and major tube movement is announced by the Dekoron Products Division of Samuel Moore & Co., Mantua, Ohio. Being of 2-piece construction, Dekoron Hi-Duty Tube Fittings effect substantial savings in installation time—36% compared to compression fittings and up to 71% compared to flared fittings, according to the manufacturer. The fitting is delivered assembled with nut in body. The tube is merely inserted into the fitting body and the nut tightened. This shears the sleeve from the end of the nut and the sleeve then attaches itself tightly to the tube for a pressure-tight, leakproof joint. There is no loose sleeve, no

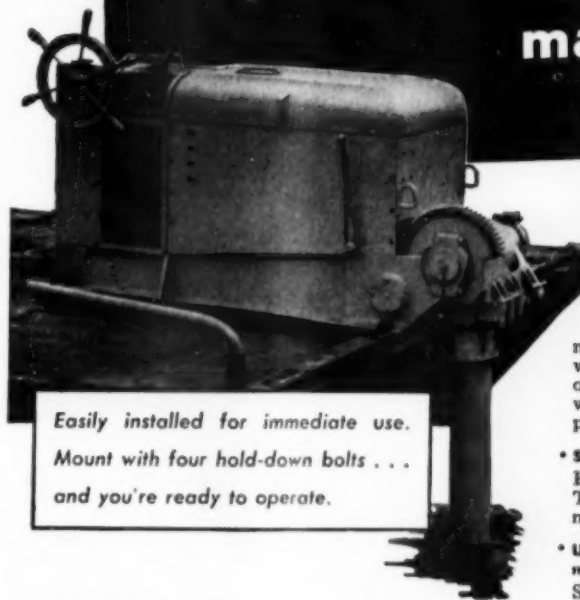


flaring or special preparation of tubing. Full details and specification data are available on request to the company.

HARBORMASTER

Outboard Propulsion and Steering Units

your complete marine power package



Easily installed for immediate use.
Mount with four hold-down bolts . . .
and you're ready to operate.

Specifications:

Sizes available from 20 to 300 h.p., gas or diesel power. Model 0-41H (illustrated).
Engine H.P. 50
Engine R.P.M. 2300
Propeller diameter 30"
Propeller pitch 15"
Propeller R.P.M. 608
Fuel tank 16 gallons
Cooling radiator
Height above deck 48 $\frac{1}{2}$ "
Width 36 $\frac{1}{2}$ "
Weight (dry) 2780 lbs.

Hundreds of Harbormasters are in continuous marine use in many applications. Send today for Harbormaster Catalog containing specifications and over 70 photos and diagrams.



Harbormaster Outboard Propulsion and Steering Units are complete marine power packages, ready for immediate use. Everything is included . . . fuel tank, battery, steering mechanism, even the hold-down bolts. Mount; put in fuel; start; and you're off with exceptional power and maneuverability. Harbormasters give you special features not found with ordinary marine power. They are the outstanding and practical choice for jobs where you want an easily installed marine power unit you can depend on.

• **Steers instantly in any direction with full power**
Exclusive patented M&T 360° Propeller Thrust Steering Control gives you the ultimate in maneuverability.

• **Underwater parts easily accessible for maintenance or repair**
Special 180° elevating mechanism allows one-man operator to raise entire submerged assembly to any degree he desires. No dry docking or diving for repairs necessary.

• **Provides protection in shallow water**
Patented shear pin automatically shears off should underwater assembly strike a submerged obstacle. Assembly rides over obstacle, free from damage, without loss of forward motion or operating power. Pin easily replaced while under way.

• **Economical to operate and maintain**
You realize savings in fuel expense because you get more thrust per horsepower with outboard propulsion. Harbormasters give you rugged, dependable operation with a practical minimum of maintenance and service.

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Inland River Reports

By David I. Day

TRAVELING up the Mississippi recently in the morning sunshine some 40 miles below Memphis we were much pleased with the operation of the *Dan Quinn* of the Patton-Tully fleet, headed for Illinois with several barges of petroleum products. We have a picture somewhere of that fine 1600-hp. vessel taken on her first payload trip about 13 years ago. She was built by Nashville Bridge and has twin General Motors engines.

THE *Dan Quinn* passed the *Joan Simpson* on her way down with empties. She was in charge of Capt. R. Spring. A good many will probably not recog-

nize her by that name. The boat was originally named the *F. B. Walker*, built at the F. B. Walker yards at Pascagoula, Miss. The *Joan* has Superior engines, twins, 2700 hp.

CHIEF ENGINEER Ben Powell, one of the best in the business, has only the kindest words to say for the shiny, new-looking Enterprise engine powering the *Meriwether Lewis* of the C. P. & T. line of Houston, Texas. This boat has been giving real service since she came out at St. Louis Ship in '48.

THE MOST IMPRESSIVE boat we observed above St. Louis was the "prize pusher of 1953," the *Mama Lere* of the Potter Towing Co. She was going up with 20,000 tons of coal in six big barges. In her first year (1953) she turned in the same

20,000-ton performance. She was built by the Nashville Bridge Co. Her twin model 16-278A General Motor diesels have earned widespread esteem.

COAL TOWING recently in the Pittsburgh pools on the upper Ohio dropped off due to the slack in the iron and steel industry. All the big coal shippers had tied up the steamboats and were using only the more efficient and more economical diesel boats. The only unusual sight to us was the early morning appearance of the *Lin Smith* to pick up a steel tow, running smoothly. This Houston boat has a widely reputed Cooper-Bessemer engine room, 3000 hp.

WE HAD A GOOD look at the Superior-powered *Vulcan* of the Jones & Laughlin Steel Corp. fleet—built in 1952 at St. Louis Ship. She had been undergoing repairs following an accident but was all set to go to work. The other J & L diesel vessels were busy.

IT IS STILL difficult to comprehend fully the fast passing of the steam towboat. On this trip to Pittsburgh we saw only two steamers at work. Those still remaining all together were tied up at various places for emergency use only. Jack Wiebe, Pittsburgh, noting the *R. L. Ireland* passing, remarked: "Speedy economical coal transportation like that Dravo-built boat gives is the reason that it's now King Diesel."

ST. LOUIS RIVER FOLK got their first look at the *Liberty* of the Union Barge Line, Pittsburgh, this month since she started sailing under this name. She was originally the *Johnny Walker*. Her twin General Motors engines are rated at a total of 2880 hp.

SEEING THE *Beaver* of the UBL fleet, we recalled checking her at work in either 1937 or 1938. The boys upriver called her "Old Ageless." She has been considerably rebuilt since her early success under the name of *Dravo 42*. She uses an old Nelsco engine, around 350 hp. Our sincere compliments to Engineer Al Wizba.

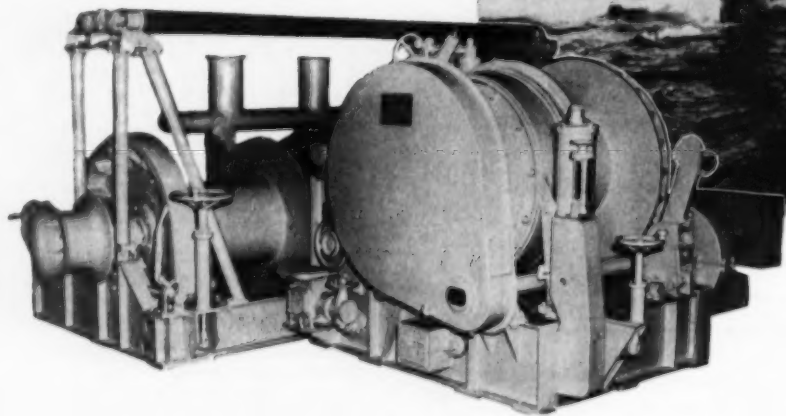
ANOTHER DIESEL vessel back at work after repairs is the *Neville* of the UBL fleet. She was downbound with 16 barges of steel and one of creosote. A nice job of piloting—probably done by Capt. Wilson Fry. This boat is another veteran—came out in 1935. Now is using GM engines, 1500 hp.

THE *Sarah Kate* of the Canal Barge Lines, New Orleans, was making fine time around Oxbow Bends below Louisville, Ky., on the Ohio. She had three barges of oil from Houston, destined for Duquesne, Pa. She has twin GM engines.

New Distributor Appointed

National Steel and Shipbuilding Corp. of San Diego, Calif., has been appointed engine parts and service distributor for the engine division of the National Supply Co., manufacturer of Superior and Atlas engines. National Supply's San Diego branch has been closed and William Haull, branch service engineer, and Harold Emmanuel of the parts department have joined the organization of National Steel and Shipbuilding Corp. The new distributor is located at 28th St. and Harbor Dr.

To Free the Seas



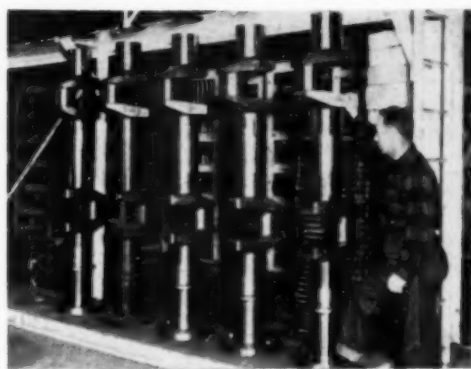
These speedy Minesweepers of the AM-421 Class will serve the nation, should the need arise, in protecting our fleet by clearing the waters of destructive mines in the safest, fastest and most efficient manner yet devised.

From stem to stern, each one of these sleek craft has been the work of specialists in their field. It was our privilege to furnish the non-magnetic Combination Mine Sweeping Winches and Automatic Towing Machines. Designed to conserve valuable space on deck, the two units were coordinated into a single piece of equipment. Such a demand, though presenting a challenge, is not uncommon with us since all Johnson-Type Marine Auxiliaries are custom-built, designed specifically to do the particular task at hand.

ALMON A. JOHNSON, INC.

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Nodular Iron Goes Into Crankshafts



Cooper-Bessemer crankshafts made from nodular iron.

Concluding four years of testing and development work with nodular iron, Cooper-Bessemer Corp. of Mount Vernon, Ohio, reveals it has applied the comparatively new ductile material to the production of crankshafts for gas engine-driven compressors. The ductile iron used in these crankshafts provides a combination of high strength, high wearing qualities and good machineability particularly ideal for engine crankshafts. The high "notched endurance limit" characteristic of nodular iron makes the metal especially suitable for heavy-duty crankshaft service, according to the manufacturer.

The physical properties of nodular iron show an interesting comparison to the properties of forged steel traditionally used for such engine parts. The company reports these comparisons:

	Ductile Iron	Forged Steel
Tensile strength	79,200 psi.	80,100 psi.
Endurance limit (smooth bar)	31,500 psi.	35,000 psi.
Endurance limit (notched)	20,750 psi.	17,800 psi.
Modulus of elasticity	22,600,000	29,000,000
Brinell hardness	220	170

Cooper-Bessemer was one of the first companies to initiate development work on high strength irons. Research began in 1935 and actual development work on nodular iron started in 1949. The first ductile iron crankshaft was shipped last summer.

Briggs Promotes Eichelberger



W. Eichelberger

The Briggs Filtration Co. of Washington, D. C., maker of industrial and automotive oil filters, announces the promotion of Willard Eichelberger, formerly a Briggs field engineer, to manager of the engineering department.

Mr. Eichelberger formerly was associated with the American Oil Co. where he was a field engineer for seven years.

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Atlas Diesels for Towboats

Two 290-hp. Atlas diesel engines will provide power for the five twin screw towboats being built by the Dravo Corp. The Atlas diesel engines being supplied by the National Supply Co. are 4-cycle turbo supercharged model 35-S2X-6 six cylinder and rated at 290 hp. at 1200 rpm. They will drive two propellers in Kort nozzles through hydraulic couplings and reduction gears.

In addition to their propulsion duties, the engines will drive a 10-kw. auxiliary generator from its front end power take off while the other engine will drive the pump in the hydraulic steering system from its power take off.

Caterpillar Forms Credit Corporation

Formation of Caterpillar Credit Corporation, a wholly-owned subsidiary which will assist its domestic and Canadian dealers in financing time payment sales, has been announced by Caterpillar Tractor Co., Peoria, Illinois.

Caterpillar will invest capital in the subsidiary as funds are required. This investment will be supplemented later by bank borrowings by the subsidiary. A. T. Brown, executive vice president, said the credit corporation is not intended to compete with banks or finance companies, but rather to provide dealers with an additional credit source when others have been exhausted.

"AMOT" is standard ON PACKARD DIESELS



SPECIAL ENGINE
MOUNTED UNIT



SHIPYARD INSTALLED UNIT
WITH NAVY FLANGES

AMOT thermostats have offered the following advantages to Packard over all other makes of automatic cooling water temperature regulators:

- 1. Large capacity combined with light weight.
- 2. Excellent reliability even under extreme shocks and vibration.
- 3. No external bulbs or tubing to break and cause trouble.
- 4. Operating forces are very large and with no packing glands, there is no chance of valve ever sticking or becoming in-operative.
- 5. Holds close regulation and is not sensitive to pressure.
- 6. Temperature is fixed and cannot be tampered with.
- 7. Because of its simple and rugged construction practically no maintenance is ever required.
- 8. Compact in size, and will operate in any position, which facilitates piping.
- 9. Has positive 3-way action.
- 10. Prices are competitive.

Write for the name of your nearest AMOT representative, who will be glad to go over the application of an AMOT thermostat for either jacket water or lubricating oil temperature control to any gas or diesel engine installation using up to 6" piping. AMOT catalogs are available on request.

AMOT CONTROLS CORPORATION, RICHMOND 1, CALIF.
(FORMERLY AMERICAN MOTORS CO.)

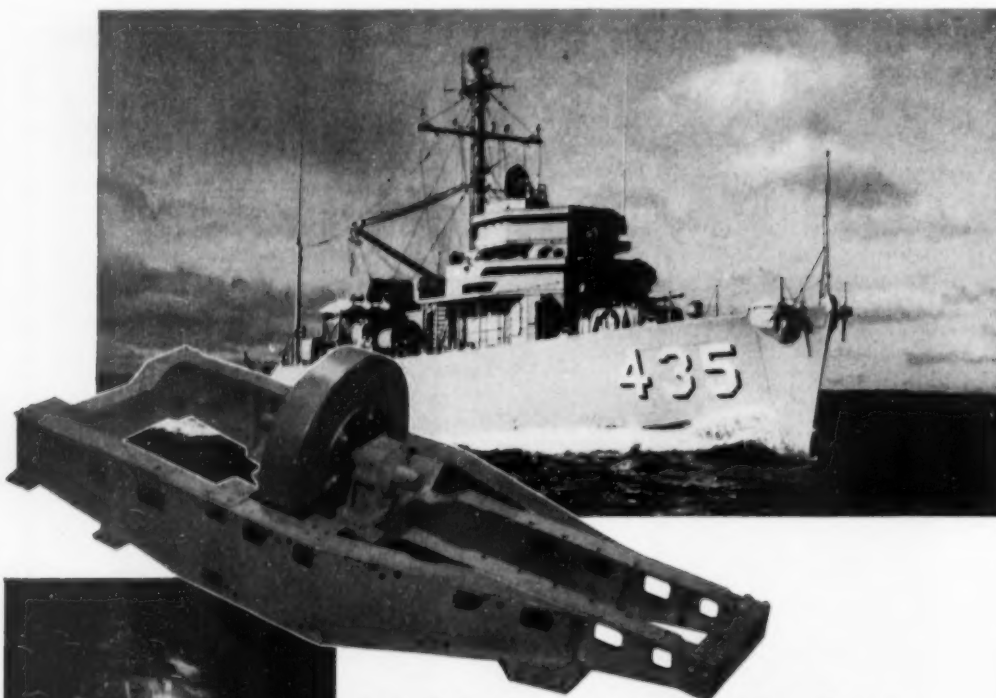
Dual Ceremony Marks Opening

A diesel locomotive parts warehouse and office built to serve more than 50 railroads in the Southwest was opened in St. Louis, Mo., recently by the American Locomotive Co. Besides dedicating its new facility, Alco delivered its 10 millionth diesel horsepower, contained in a dual-purpose 1600-hp. road locomotive to the Missouri Pacific Railroad. H. M. Johnson, representing Mopac, accepted a plaque from Alco President Perry T. Egbert commemorating the event.

Alco's new warehouse, constructed of structural steel and asbestos-coated steel sheathing, contains 30,000 square feet of floor space.



Perry T. Egbert (right), president of American Locomotive Co., presents plaque to H. M. Johnson of Missouri Pacific Railroad, executive assistant to P. J. Neff, Mopac's chief executive officer.



World's First Lightweight Aluminum Sub-Base for Heavy-Duty Marine Diesel Engines

FABRICATED BY

Creamery Package

Ribs, spacer plugs and bolt bars in sub-assembly of diesel engine base are sigma-welded to inside surface of a tie beam. Unit is clamped flat to prevent possible distortion from welding heat. Far end has been cold-bent upward in 30° angle.



Final welding assembly. Engine base is positioned on a rotatable fixture which can be rolled to any part of the shop for finishing operations. Note heavy aluminum pads on underside of frame.

Creamery Package manufactures for Packard Motor Car Company the sub-base and fly wheel assembly on which is mounted the Packard Diesel engine for use on U. S. Navy Minesweepers.

CP craftsmen utilize here the same fine welding techniques used in fabricating the finest stainless steel processing equipment for the food industry.

Creamery Package not only manufactures a most complete line of food processing and refrigerating machinery, but also devotes facilities to jet engine assemblies and parts for electronics equipment, in addition to the minesweeper program pictured here. CP's versatile engineering staff is always anxious to meet the challenge of new products.



THE Creamery Package MFG. COMPANY

General and Export Offices: 1243 W. Washington Blvd., Chicago 7, Illinois

FACTORIES: Arlington Heights, Illinois • De Kalb, Illinois
Port Atkinson and Lake Mills, Wisconsin • Derby, Connecticut

BRANCHES IN 22 PRINCIPAL CITIES

Chevron Pressure Primer System

Operators of heavy-duty diesel and gasoline engines will be interested in Standard Oil Co. of California's new Chevron pressure primer system, designed to quick-start all types of internal engines at temperatures as low as 65 degrees below zero. The system uses Chevron priming fuel packaged under 250 lbs. of pressure in a 9.9 cc. steel bulb with welded closure. The priming fuel is a highly combustible material that permits the engine to run until it can build up enough heat to operate on its regular fuel.

The operator controls the release of the bulb from the cab by a small discharger installed on the dashboard. When priming fuel is needed, a bulb is placed in the discharger, a lever is pushed which pierces the sealed cap of the bulb and directs the priming fuel through a small tube connected to the engine air intake system. The fuel enters the engine in a finely atomized spray. It is a simple operation featuring maximum safety. The Chevron bulbs are built to withstand between 6000 and 8000 lbs. hydrostatic pressure in temperatures of over 600°F. without rupture to provide maximum resistance to accidental release of the fuel. In addition, they are cadmium plated to prevent corrosion while in storage. The discharger is waterproof and dustproof, and is designed to eliminate escape of flammable material.

The system is available from Standard Oil Co. of California, San Francisco; California Oil Co., Barber, N. J.; The California Co., Denver; Standard Oil Co. of Texas, El Paso; and Standard Oil Co. of British Columbia, Vancouver.

Cooper-Bessemer Promotions



R. F. Lay



E. L. Miller

Two promotions are announced by Cooper-Bessemer Corp., Mount Vernon, Ohio. Robert F. Lay has been appointed assistant general sales manager, according to Stanley E. Johnson, Sr., vice president in charge of sales. Mr. Lay formerly was chief engineer of the product division. He joined Cooper-Bessemer in 1924 and later became associated with Baldwin Locomotive Co. and the Elliott Co., returning to Cooper-Bessemer in 1946 as head of the stationary engine section.

The promotion of Eugene L. Miller to assistant general manager was announced at the same time by Gordon Lefebvre, president and general manager. Mr. Miller was graduated from Oklahoma A & M with a mechanical engineering degree in 1941 and served as an Army officer for four years. He joined the firm upon leaving the service and was supervisor of application engineering at the time of his promotion.

DIESEL PROGRESS

New Line of Plastic Hose, Pipe



Representative group of Fluoroflex-T products produced by Resistoflex Corp., Belleville, N. J. They include hose and hose assemblies, pipe and tubing, as well as valves lined with Fluoroflex-T.

Its new line of Fluoroflex-T plastic hose and pipe products that are chemically inert to highly corrosive liquids has been announced by the Resistoflex Corp. of Belleville, N. J. Fluoroflex-T, made from DuPont's fluorocarbon resin known as Teflon, is light in weight and resistant to high and low extremes of temperature. The new hose is already in production on a pilot-plant basis to meet the needs of the aviation industry for handling synthetic oils and fuels developed for use on the latest design jet engines, according to Edgar S. Peierls, president of Resistoflex Corp.

Mr. Peierls said he expects that Fluoroflex-T hose will also find application on guided missiles which use extremely corrosive fuels and oxidizing agents. Another application of the hose will be for all hydraulic systems requiring non-corroding conduit. Commercial production of the new line of hose and pipe will be expanded to serve industries confronted with the problem of handling destructive corrosive fluids at high operating temperatures.

Fluoroflex-T products can handle practically all corrosive liquids at temperatures from -100°F . up to at least 450°F . without physical, structural or visual changes. The new line has high tensile strength and practically unlimited shelf life, according to Mr. Peierls and Irving D. Press, chief engineer of Resistoflex. Fluoroflex-T hose is available in seven sizes that range from a quarter of an inch to an inch, and three additional sizes soon will be added. Fluoroflex-T pipe, which is a lamination of fluorocarbon resins with glass fabric, is available in diameters of 1, $1\frac{1}{2}$, 2, 3, and 4 in., and special sizes can be produced.

Fairbanks, Morse Plant Opens

One of the newest and most modern pump plants in the nation—geared to an annual output of enough pumps to move 35 billion gallons of water or other fluids a day—was dedicated and opened to the public recently by Fairbanks, Morse & Co.

New Fairbanks, Morse & Co. pump plant at Kansas City, Kansas.

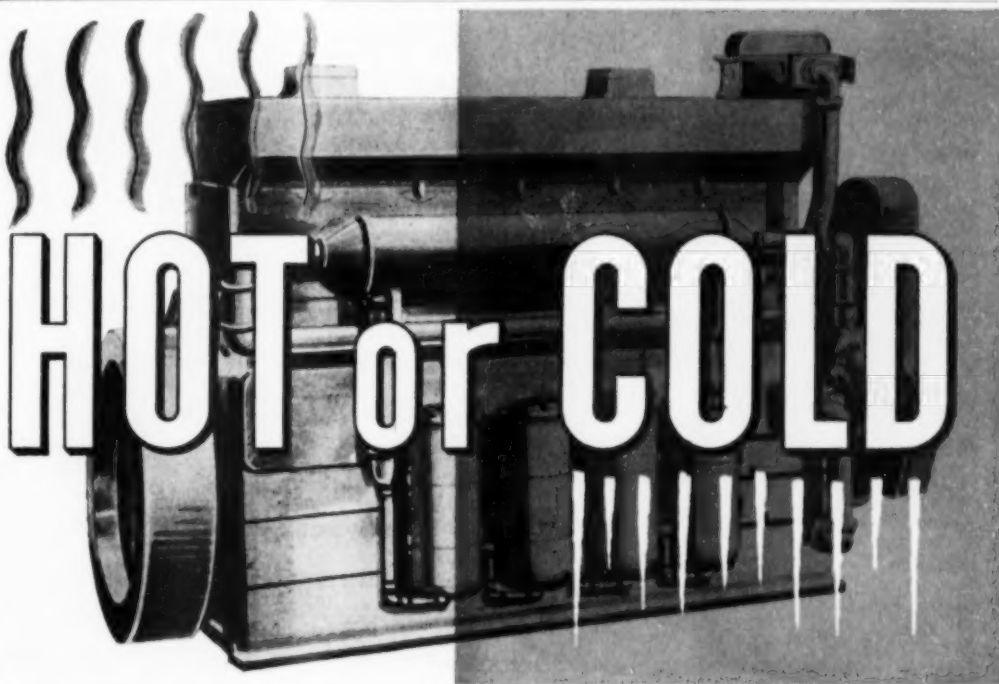


in a 4-day ceremony at Kansas City, Kan. A highlight of the program was an industry-wide forum on hydraulics and the problems arising from the increased demand for water. Among the experts in hydraulics and educators taking part were Dr. Francis M. Dawson, dean of the college of engineering at Iowa State University, who served as chairman, and Dr. Robert T. Knapp of California Institute of Technology. Speakers included Dr. Richard G. Folsom of the University of Michigan and Gail A. Hathaway, special assistant to the chief of engineers, Department of the Army.

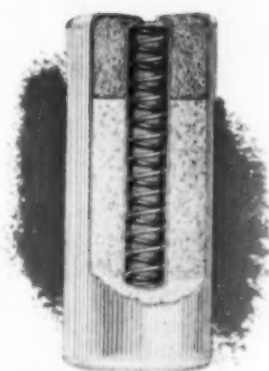
An estimated 900 persons will be employed when the plant, located on a $38\frac{1}{2}$ -acre site, is in full operation and turning out built-together, side suction,

trash, angle-flow, split-case and steam and power reciprocating pumps and "Z" engines ranging from 2 to 30 hp. The plant layout includes a completely mechanized foundry able to turn out 70 tons of castings a day; a manufacturing department of 190,000 square feet; two test laboratories; and a 2-floor office section.

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PROTECTED AT ALL TIMES



CP* Controlled Pressure elements are the subject of an interesting and helpful booklet, that can save you money. Write for your copy today—it's free, of course.

You know that engines are completely protected only if the lube oil is filtered under *all* conditions. It is essential that dangerous particles be removed when the oil is cold and viscous, just as it is under normal operating temperatures. When you have less than full-flow filtration, you may not be protecting critical surfaces, if a part fails or if oil is contaminated at the start, because the oil is by-passed around the filter element.

In a Winslow CP* element, cold oil *immediately* flows through the coarser section of filter material, which accepts the oil and removes all critical particles. As the temperature rises, more of the oil flows through the dense section of the element, assuring complete filtration at all times. The proportion of coarse and dense filtering media has been determined by laboratory research and field testing for each size of filter, and is an exclusive design feature of Winslow CP elements.

Winslow filters are your assurance of longer oil life and maximum engine protection under all operating conditions.

WINSLOW FILTERS

Winslow Engineering Company

4069 Hollis Street • Oakland 8, California

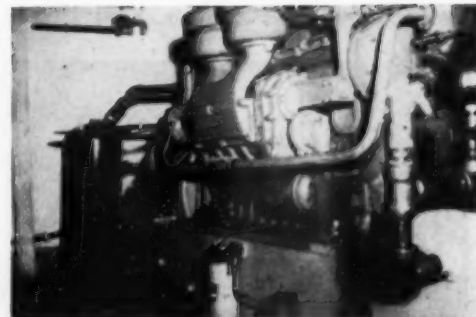
Aqua-Clear Feeder Installation

"Clean fuel, lube oil and water" is a constant chant every engine operator listens to and plays himself. The diesel engine he operates represents a capital investment which, as every buyer expects, will deliver productive work for a long, long time. It is not only because of the inherent qualities of the diesel engine that these expectations are fulfilled but also because of the great care given to insure clean fuel, lube oil and water.

The big bugaboo of the water circulatory system of any engine is the rust, corrosion and electrolysis factors. Every water-cooled engine is susceptible to this. In the long run, these are the major fac-

tors necessitating replacement of cylinder liners. In the case of marine diesels which are salt water cooled, replacement of liners because of electrolytic action is very common despite the use of zinc plates to combat this. Even closed cooling systems are liable to corrosion due to electrolytic action when two different types of metal are used in the construction of the heat exchanger.

Filtration is not the answer to this particular type of engine wear. Other means are required to remedy the condition. A new product manufactured by Sudbury Laboratory is offered as a solution to the problem. This product is a special crystalline substance which is slowly dissolved and permitted to pass into pipes, tanks, engine mani-



Installation of an Aqua-Clear Feeder (the unit is shown at left in the photograph) solved the problem of rust, corrosion and electrolytic action in the water circulatory system of this GM diesel.

folds, or wherever water is used. The crystalline substance in solution has a particular affinity for any metallic oxide. It attaches itself to the oxide and in a very short time covers the entire metal surface with a coating that completely seals it against contact with water or air. Since the film does not build up on itself, it remains microscopically thin and does not interfere with heat transfer or the flow of water. The substance is claimed to be both harmless and tasteless when used in drinking water to protect such piping.

They are known as the Aqua-Clear Crystals. Passage into the circulatory system is achieved by means of the Aqua-Clear Feeder which is placed in the water line. As water passes through it, the crystals are slowly dissolved. Feeders are made in both metal and plastic and in various sizes. The application of Aqua-Clear Crystals on numbers of engines has proved their great value, according to the manufacturer. This is emphatically so in the case of marine installations. It has resulted in clean cooling water permitting higher operating temperatures, greater engine efficiency and a much better maintenance record. For further information, write DIESEL PROGRESS, File No. 114, Box 8458, Cole Station, Los Angeles 46, Calif.



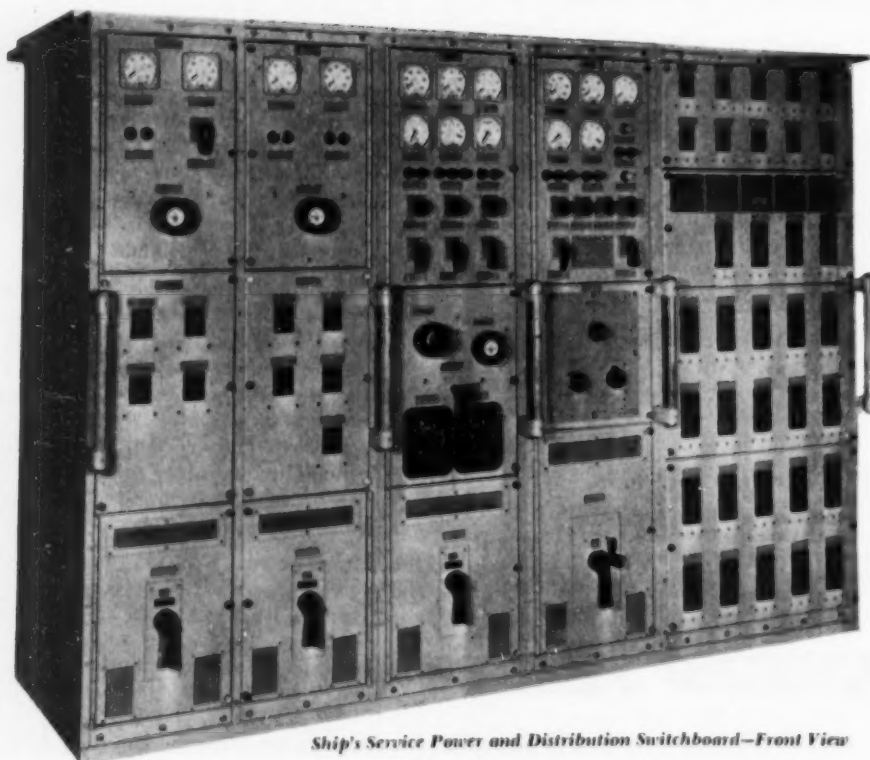
Test Switchboard—Front View

We are Proud...

to have furnished the non-magnetic ship service switchboards and electrician test switchboards for the new non-magnetic minesweepers. Jacksonville Metal & Plastics Company, manufacturers of electric switchgear, switchboards, name plates and cable tags of all descriptions, Jacksonville, Florida.

Jacksonville Metal & Plastics Company

575 Dora Street
Jacksonville 4, Florida



Ship's Service Power and Distribution Switchboard—Front View

Perelle Heads American Bosch, Arma



Chas. W. Perelle

Charles W. Perelle, for the past five years president and general manager of ACF-Brill Motors Co., has been elected president and a director of the American Bosch Corp. and its subsidiary, Arma Corp. He succeeds Donald P. Hess as president of American Bosch and Kenneth H. Rockey as president of Arma. Mr. Hess has been named chairman of the board. Besides his connection with ACF-Brill, Mr. Perelle has been vice president in charge of manufacturing and a director of Hughes Tool Co., general manager of Hughes Aircraft Co. and a director of Trans-World Airlines.

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D9X Undergoes Extensive Testing



The D9X, described by the Caterpillar Tractor Co. as the world's largest, most powerful crawler tractor, will be tested extensively this summer for earth-moving, pipeline clearing, strip mining, spoil bank handling and other heavy-duty jobs. On-the-job testing of the new machine, sixth member of Caterpillar's crawler tractor family, began recently on a logging project for the Weyerhaeuser Timber Co., Vail, Wash. Of the nine other D9X's to be assembled, two will be retained for control tests by Caterpillar at Peoria, Ill., and Phoenix, Ariz.

Tentative specifications list the machine as 18 feet long, 12 feet wide and 10 feet high. The bare unit weighs 51,500 lbs., the blade and cable control another 11,000 lbs. Horsepower setting of the engine will be commensurate with the machine's size and weight. The D9X incorporates many features of other Caterpillar track-type tractors, such as the fuel injection system and 4-cycle engine. Five of the test machines will have new oil-type clutches and the others will have torque converters. The test units are supplied and maintained at Caterpillar's expense, following the company's practice of conducting experimental work under users' actual job conditions and by users, and will be returned to the factory at the end of the season.

Roadway Express Buys 124 Tractors

The vanguard of a fleet of 124 Mack tractors for Roadway Express, Inc., is shown in the accompanying photograph at the company's terminal in Akron, Ohio. James A. Motsinger (at left), Roadway's assistant superintendent of maintenance, accepts keys to the new tractors from Everett W. Atherton, Mack's Akron district manager. The units are cab-over-engine H-61T models powered by 170-hp. Mack Thermodyne diesel engines. They are also equipped with sleeper cabs. Roadway Express, one of the nation's largest motor carriers, has ordered 135 trailers in addition to these Macks.



New Buda Fork Lift Trucks

Development of two new models of pneumatic tire fork lift trucks, the FTP40-24 (gasoline) and FTPD40-24 (diesel), is announced by the Buda Company, division of Allis-Chalmers Manufacturing Company, Harvey, Illinois.

Rated at 4,000 lb. capacity at a 24-in. load center, Buda's new models offer functional, modern style and features that assure fast handling, operating economy and low maintenance. Included are: full front-vision instrument



panel; automotive type single lever gear shift mounted on steering column; fingertip, flip-over parking brake; quick change heavy-duty clutch; self-energizing brakes; and center point steering.

Model FTPD40-24 is powered with a Buda 4-cylinder, 40.5-hp. diesel engine, model 4BD-153. Model FTP40-24 is powered with a Buda 4-cylinder, 49-hp. gasoline engine, model 4B-153. The engine parts are 85% interchangeable.

Both models are available in five standard mast heights with lifts of 72, 84, 108, 114 and 120 in., and also are available with torque converter at additional cost. Further information and free literature may be obtained by writing to Buda.

A 200 M.P.H. CYCLONE GIVES U.S.S. ENDURANCE 66% MORE STEAM GENERATING POWER PER SQUARE FOOT!



ONE OF TWO CYCLOTHERM HEATING BOILERS INSTALLED ON UPPER MACHINERY FLAT

Because ship's space is at a premium, the U.S. Navy chose the smallest firetube boiler per capacity . . . Cyclotherm. Another recent installation is the Sinclair Chicago, Sinclair Refining Company's only Lakes vessel. The complete line of Cyclotherm Marine Boilers complies with all Coast Guard and ABS marine specifications.

CYCLOTHERM... SAVES SPACE AND COSTS!

Cyclotherm Heating Boilers and Steam Generators need only 3 sq. ft. of heating surface per boiler horsepower . . . instead of the 5 sq. ft. demanded by old-fashioned boilers. 66% more steam generating power per square foot!

A single pass of the return tubes gives you more than 80% efficiency in heat transfer . . . 65% from the combustion chamber and more than 15% from the return tubes. From a cold start to full power takes only 15 to 20 minutes.

You save as much as 50% in maintenance costs. A cyclone of flame cleans the main combustion chamber . . . the single pass of return tubes are easily accessible for cleaning from the rear of the unit.

On units from 10 to 60 HP, the burner shuts down when steam demand is satisfied . . . automatically starts when steam is needed. On units from 80 to 500 HP, precision equipment modulates firing rate from 30-100% of capacity, thereby meeting your minimum as well as your maximum steam demands at peak efficiency.

The secret of Cyclotherm is its patented Cyclonic Combustion. A flaming cyclone . . . the length of the entire furnace . . . swirls at approximately 200 m.p.h. A blanket of air protects chamber walls from direct contact with the flame . . . whose concentrated proximity assures a high rate of heat transfer unequalled by any other combustion method.

Cyclotherm Heating Boilers and Steam Generators are used in industry, shipping, commercial establishments, institutions and public buildings. Discover how Cyclotherm can give you more steam power per dollar. Write today for your free illustrated folder.



CYCLOTHERM DIVISION U. S. RADIATOR CORPORATION, DEPT. D, OSWEGO, NEW YORK

YOU Save up to 50% on diesel cylinder heads

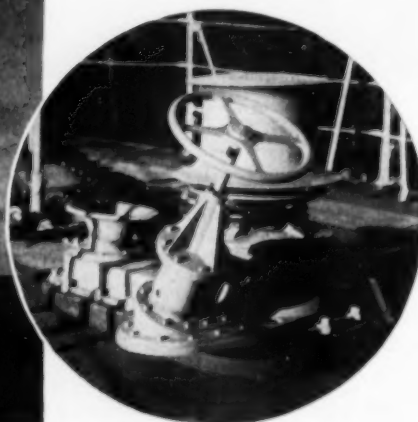
EXCHANGE your cracked or broken

Diesel heads with genuine Guth Company renewed heads . . . guaranteed equal to new. You save up to 50% in cost . . . and get your equipment back into service quickly. Guth prepays outbound freight — return your damaged part after the renewed one reaches you. You'll save time and money with Guth:

IMMEDIATE SHIPMENT FROM GUTH COMPANY STOCKS OF DIESEL HEADS

Caterpillar	Waukesha
International	Cummins
Buda	and many other popular makes

Emergency
service day or night . . .
just phone 1259 or wire
GUTH COMPANY at
McPherson, Kansas.



The Anchor Windlass built by Ideal which is located on the fore-castle deck. The motor and gear case drive unit is located in the windlass room just forward of the forward upper crew compartment.

NO COMPROMISE WITH DEPENDABILITY •

Throughout World War II, Ideal Windlass Company supplied the Navy and commercial shipping with dependable, quality-engineered deck machinery. Again, Ideal is proud to have supplied three sets of equipment for the U.S.S. Endurance.

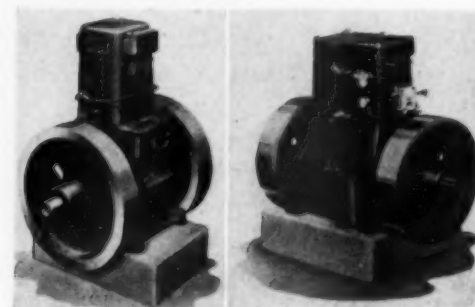
The sets include: (1) The Anchor Windlass of 20 hp. for the 1 1/8" stud link chain. Weight of anchors is 1700 lbs. Capstan diameter is 18". (2) The Magnetic cable reel winch. (3) A Special Device Reel.

Wherever quality engineering and the utmost in dependability is specified, Ideal delivers the equipment.

IDEAL WINDLASS CO., Inc.

P.O. Box 430
East Greenwich
Rhode Island

Bamfords' Slow-Speed Diesels



Bamfords' Z2 single cylinder diesel engine, left, rated at 4 1/2 bhp. at 600 rpm., and Z8 twin cylinder diesel, rated at 16 bhp. at 700 rpm.

In line with an expanded range of applications of small, slow-speed diesels in a variety of fields, Bamfords, Ltd. of England has appointed International Selling Corp. of New York as exclusive distributor of Bamfords' slow-speed diesels in the United States, Canada and Mexico.

Bamfords' single and twin cylinder slow-speed diesels, which feature a hinged crankcase and a detachable governor, range from 3 1/2 to 16 bhp. at 600 to 700 rpm. The seven models in the Bamfords line are of direct injection type, which provides efficient combustion at all loads and minimum deposit over long periods. Each model is quickly started by hand under all weather conditions, and all can be equipped with auxiliary starting devices. They are easily coupled and require no speed reduction unit for most driven equipment.

Because of their versatility these diesels have found applications in agriculture, on construction jobs, in lumber operations, industrial plants, oil fields and refinery work and on fishing boats and irrigation projects. Slow-speed diesels are rated more economical than high-speed engines because their slower speeds give more efficient combustion that results in lower fuel consumption per bhp. hour. The valve arrangement—overhead exhaust and screened inlet valves operated by a single cam—functions with a minimum of working parts.

Fewer parts operating at low speeds decreases wear and cuts maintenance costs. Main bearing and rockers in Bamfords' twin models have pressure lubrication. Replacement of the cylinder unit is unnecessary because the cylinder liner is renewable. Simplicity in design facilitates maintenance, which helps assure longer service and reduce repair time and effort. The patent hinged crankcase permits easy access to working parts for inspection and repairs without removing the cylinder head or disturbing the injection system. The governor is a block unit, enclosed and self-contained, which can be detached without interfering with other parts.

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How much of your engine maintenance bill is due to repair of breakdowns that could have been avoided—if you'd had advance warning?

At a fraction of that cost, Alnor Exhaust Pyrometers offer you a constant check of engine performance—advance warning of

**Cylinder Overload Preignition
Scaled Jackets Clogged Ports
Detonation Faulty Injection**

Get the best from your diesel—minimum fuel consumption per horsepower and long service uninterrupted by foreseeable breakdowns. Get constant protection of your engine, cylinder by cylinder, with an Alnor engineered Exhaust Pyrometer System.

Get Full information—Quickly! Your nearby Alnor Diesel specialist is conveniently listed in the classified directory. Ask him to help you select the Pyrometer and thermocouple assembly designed for your engine. Or send for Bulletin 4361 with complete details of the full Alnor line of Pyrometers.

★ **Navy's New** ★
Minesweeper Fleet ★
Powered by Packard ★
★ **PROTECTED** ★
by Alnor ★
PYROMETERS ★

ILLINOIS TESTING LABORATORIES, INC.
Room 508, 420 N. La Salle St.,
Chicago 10, Illinois

New Design Ups Power Ratings

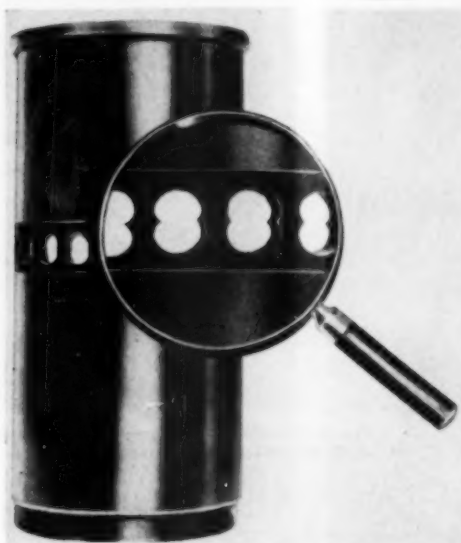


Figure 8-shaped openings in the cylinder liners of new General Motors 6-110 diesel engines promote freer "engine breathing" and permit higher engine speeds for increased power output.

Design changes which have increased the output of General Motors' single 6-110 diesel engines to 300 hp. maximum and 230 hp. continuous have been announced by GM's Detroit Diesel Engine Division. The increases, totaling 25 and 17 hp., respectively, provide extra power which will be especially useful in heavy duty hauling vehicles, shovels, cranes and other installations subject to sudden load increases. According to the manufacturer, the power increase in these 2-cycle diesels is the result of freer "engine breathing" and higher engine speeds. Freer breathing has been accomplished in part by increasing the number of ports in the cylinder liners, and the ports have been grouped together in partially overlapping pairs to form larger, figure 8-shaped openings.

With the increased scavenging capacity thus provided and because the inherent strength of structural parts allowed it, maximum engine speed has been increased from 1800 to 2000 rpm. The continuous operating speed is now 1800 instead of 1600 rpm. According to Detroit Diesel spokesmen, these increased engine speeds were set only after thousands of hours of operation proved them to be consistent with long engine life expectancy.

Other changes which contribute to greater operating efficiency and longer engine life include a new "high valve" injector similar to that recently introduced on the series 71 models, new roller bearing idler gear mountings and larger piston struts to add strength and rigidity to the pistons. An SAE #1 flywheel housing size is also being offered which permits the use of additional standard transmissions without the use of an adapter ring.

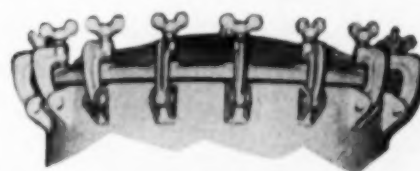
Increases Output Ratings

The National Supply Co., Engine Division, Springfield, Ohio, announces that its Model 65 supercharged 6 and 8 cylinder stationary diesel engines are now available with output ratings of 1325 and 1765 Bhp respectively. The higher ratings are the result of a change in supercharging, which raises the BMEP to 152 psi. Reprinted bulletin No. 5202 lists the new ratings of the engines.

IF YOU ARE BUYING FULL FLOW OIL FILTRATION

WHY not get the **FILTER AND CARTRIDGE COMBINATION** THAT GIVES YOU ALL of the features you want?

LOOK AT THIS ↓



Briggs
PIONEERS IN MODERN
OIL FILTRATION

**"EASI-LIFT
C-CLAMP
COVER"**

No lost motion, no fooling around with nuts and bolts . . . **NO TOOLS NEEDED.**

**GET A FILTER TANK
TAILORED TO YOUR
NEEDS**

Briggs tanks are highly flexible, no long waiting period for delivery, **INLET AND OUTLET** size and connections where **YOU** want them.

**WORKING PRESSURES UP TO
125 P.S.I., ALL STEEL, SEAMLESS
DEEP DRAWN TANKS**

FULL FLOW

**From 25 G.P.M. to 400 G.P.M.
With the Patented
All-Cellulose**

Briggs
PIONEERS IN MODERN
OIL FILTRATION

**DISC-PAC
CARTRIDGE
HIGH FLOW RATE
HIGH DIRT PICK UP
HIGH DIRT RETENTION**

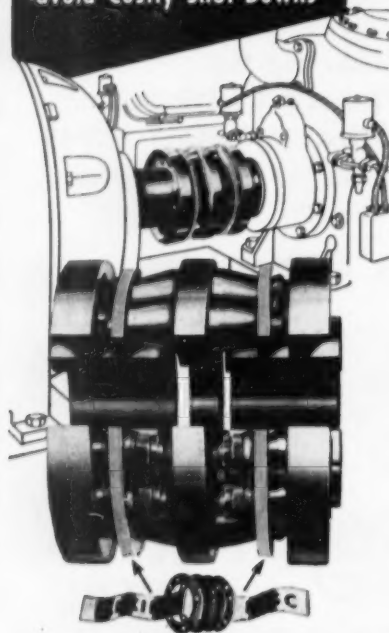
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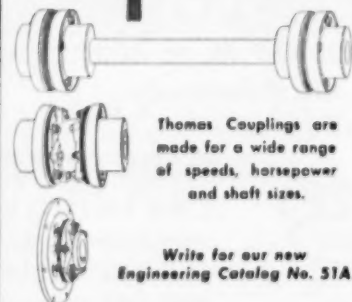
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FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
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NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.



The M/V *Cotton Bay* sailing through the ship channel from Government cut to the port of Miami docks after its conversion to a refrigerator vessel at Marine Basin in Brooklyn.

THE THREE BAYS

By Ed Dennis

ONE of the most important conversion jobs done this spring as far as Florida is concerned was the recreating of three ex-Navy vessels into modern, up-to-date refrigerated ships. Both the M/V *Winding Bay* and the M/V *Cotton Bay* are former Navy minesweepers (the latter was the *A. M. 290*) and were built by the General Engineering & Drydock Co. at Alameda, Calif., in 1946. In 1949 they were converted to general cargo vessels by the Harrisville Co. of Jacksonville, Fla. With the formation of the Three Bays Line both vessels were sent to Marine Basin in Brooklyn, N. Y., for a change-over to refrigeration.

The third ship, the M/V *Ariana*, also led a colorful life. Built as a Canadian corvette in Ontario and finished in the Boston Navy Yard, it was finally converted to a refrigerated vessel in 1948.

Formation of the Three Bays Line in Miami marks a major event; for the first time since the war's end, Miami will be the home port for regular scheduled cargo and refrigerated vessels servicing South America and the Caribbean area. It was sparked by the drive and vision of Arthur V. Davis, its founder and chief stockholder, who is also chairman of the board of Aluminum Company of America and holds interests in numerous companies in southern Florida. The Three Bays vessels will ply regularly between Miami, Tampa, Jacksonville, Galveston, the Virgin Islands, Aruba, Venezuela, Colombia, Panama, and other Caribbean ports.

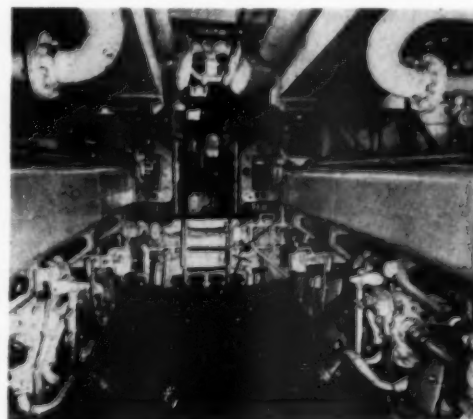
The M/V *Cotton Bay* and the *Winding Bay* are twin-screw vessels and have the following dimensions: over-all length, 199 ft. 9 in.; beam, 34 ft. 6 in.; depth, 21 ft. 3 in.; gross tonnage, 998. The main propulsion units are two 8-cylinder Cooper-Bessemer diesel engines with Buchi turbochargers developing 900 bhp. each at 720 rpm. Auxiliary power is supplied by two model D364 Caterpillar diesel engines with General Electric 150-kw. generators and one General Motors series 71 diesel engine with a 30-kw. Delco Remy generator. Compressed air is provided by two Gardner Denver air compressors which have mounted on them Air-Maze filters and Wagner Electric motors.

The main engine on the M/V *Ariana* is a 10-cylinder

der opposed piston type Fairbanks-Morse diesel engine of 1800 hp. For auxiliary there are two 100-kw. Superior diesel generating units and two 60-kw. Crossley diesel generating sets. The *Ariana* has the following dimensions: over-all length, 211 ft. 10 in.; beam, 33 ft.; gross tonnage, 750.28 R. T. The speed of all three vessels ranges from 13½ to 15 knots.

The refrigeration systems for these vessels were installed at Marine Basin, Brooklyn, this year in cooperation with the Carrier Corp. and the engineers of the Three Bays Line, and feature extreme versatility. A Carrier direct expansion Freon system with three 50-ton compressors is capable of maintaining zero-degree temperature in all three cargo holds of each vessel if needed. However, it is anticipated that the vessels will normally run north with a full cargo of bananas to Texas or Florida ports; with this in mind, the holds can be well aerated and maintained at whatever temperature is needed in any or all holds.

The establishment of this new Florida shipping concern is not a spur-of-the-moment move. During the past six months the company has been running trial voyages and setting up branches in the Caribbean area. The sailing of the M/V *Cotton Bay* under the command of Capt. Lloyd J. Decker recently on its first regular run might foretell making Miami the "gateway to Latin America."



The two 8-cylinder Buchi turbocharged Cooper-Bessemer diesels rated at 900 bhp. each at 720 rpm. on the M/V *Winding Bay*. The main propulsion on the *Cotton Bay* is the same.

Purolator Appoints Officers



J. G. Van Nest

H. W. Thogode

Appointment of Joseph G. Van Nest as vice president in charge of purchasing and Herbert W. Thogode as a director and secretary-treasurer of the company is announced by President Ralph R. Layte of Purolator Products, Inc., Rahway, N. J. Mr. Van Nest was formerly director of purchases, and prior to his association with Purolator was general purchasing agent for the Mack Manufacturing Corp., Allentown, Pa. He is an active member of the Purchasing Agents Association of New York. Mr. Thogode, a native of Brooklyn, N. Y., started with Purolator as an accountant in 1924, a year after the firm was founded. He was elected a director to succeed the late Carl M. Owen.

New Field Type AC Generators

The Katolight Corp. of Mankato, Minn., announces a new series of revolving field type ac generators, streamlined and up to 35% smaller in size than previous designs, with frames of fabricated steel construction, oversize ball bearings and equipped with cast iron endbells and direct connected exciters. They are available in 1800 rpm., four pole, 3-phase, 60-cycle from 208 to 600 volts in sizes from 60 to 150 kw. The generators are also available in single-phase, 115/230 volts from 40 to 100 kw. The new series also includes 1200 rpm., six pole, 60-cycle, 3-phase models in size 40 to 100 kw. and 30 to 60 kw., single-phase, and can be had in either 2-bearing construction or single-bearing for direct engine adaption.

The generators will maintain a voltage regulation of plus or minus 2½% with an automatic voltage regulator. They are of Class A insulation with temperature rise less than 50°C. by resistance or 40°C. by thermometer, except on the 100 kw., 1200 rpm. size which is 52°C. to 53°C. rise by resistance. The efficiencies, depending on the size, are between 90 and 94%. Fifty-cycle generators are available at 83% of the capacity ranges given here. A free descriptive bulletin is available from the Katolight Corp., First Ave. at Chestnut, Mankato, Minn.

Field Sales Manager Named

John W. Frazier has been named field manager of air filter sales by American Air Filter Co., Inc., Louisville, Ky. He served as general sales manager of Trion, Inc., the past seven years and formerly was supervisor of dealer relations with Equitable Gas Co., Pittsburgh. Now with headquarters in the Oliver Building in Pittsburgh, he will work with AAF's various district sales offices across the country. Mr. Frazier's assignment is a new position with the company.

JULY 1954

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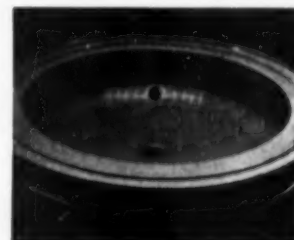


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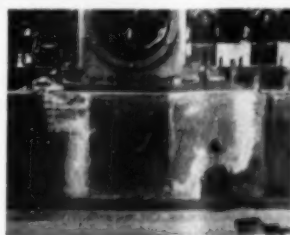
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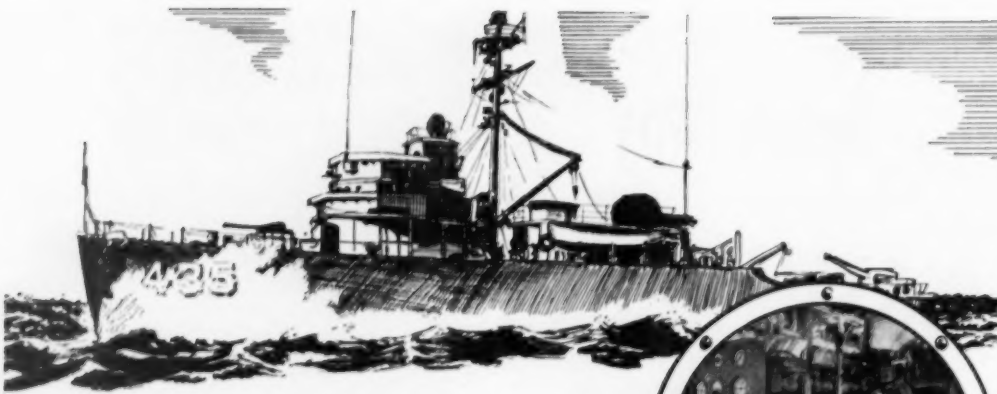
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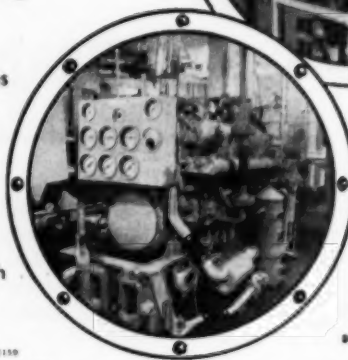
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La Favorite Rubber Expansion Joints on U.S.S. Endurance

—relieving strain on piping
—reducing vibration

It is quite appropriate that the installations shown above should be on the U.S.S. Endurance, as endurance is a major advantage in using La Favorite Rubber Expansion joints. They are made in round, square, rectangular, oval, taper and special shapes for use on pressure, vacuum and pressure-vacuum lines. Supplied with or without body reinforcing, for higher pressures and high vacuum, and with or without reinforcing rings.



ABOVE: In this view of one of the Packard 600 H.P. outboard diesels there are shown 19 La Favorite Rubber Expansion joints in pipe lines.

LEFT: A main propulsion Packard Diesel and piping in which there are 12 La Favorite Rubber Expansion joints.

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West Coast Diesel News

By James Joseph

FOR SAN FRANCISCO'S Olympian Dredging Co. the dredge *Monarch*, a GM twin torque converter replacing a steam unit. Installation and sale by West Coast Engine and Equipment Co., Berkeley.

TO QUADRUPLE HORSEPOWER in LeBoeu & Dougherty Tow Boat Co.'s *Dispatch No. 4*, a GM quad diesel with 3:1 reduction gear, replacing an older, heavy-duty engine. The tow boat firm is headquartered in Richmond, Calif.

DELIVERED to National Steel & Shipbuilding Co., San Diego, by Wilmington's J. T. Siler Co., four Pacific diesel model 1905 engines directly connected to 900 rpm., 150 kw. ac. generators. The diesels will power two 350-ton steel tuna clippers, largest constructed since 1950. The clippers are being built by National for George and Joe Soares.

LOS ANGELES' Sam Kora Trucking Co. has purchased a model RD-6572 Continental Red Seal diesel truck engine for its fleet.

SOLD TO PACIFIC Pumping Co., Oakland, two Continental (Red Seal) diesel engines, models TD-127, to drive pumps.

FOR THE CITY of Porterville's new sewage treatment plant, a 50-hp. Buda natural and sludge-gas engine, to drive an air blower.

TO CITY OF SANTA ANA, Calif., a fully automatic 300-hp. Buda diesel to act as standby for water department's Bristol Street pumping plant. The Buda drives a Byron Jackson pump.

FROM SHEPHERD Tractor and Equipment Co., a Caterpillar model D-318, 40-kw. diesel-electric set for oil well drilling in Alaska, by Havenstrite Oil Co., Los Angeles.

DELIVERED to National Supply Co., Los Angeles, two Caterpillar D-311s. The 20-kw. diesel-electric sets will be employed by drilling and exploration firms.

FOR REPOWERING a shrimp trawler, one Caterpillar 13000 diesel marine engine with twin disc reverse and 3:1 reduction gear, to Mariscos Congelados, Del Pacifico, Mexico.

SOLD BY SHEPHERD Tractor and Equipment Co. to National Supply Co. for lighting and powering drill rigs and campsites, two Caterpillar D-315, 30-kw. electric sets.

LOS ANGELES' Dale Douce Trucking Co. has purchased from Continental Motors Corp. a model RD-6572 Red Seal diesel truck engine.

UNION DIESEL, at its factory in Oakland, has under construction three model P6 diesel generating sets for the municipal plant at Cheju, Korea.

Wins Early Recognition



Making fast time through the Intracoastal Canal, up the Mississippi and Ohio Rivers, the towboat *George W. Banta* is winning an early favorable recognition in the river transportation field. She is regularly towing chemicals for the Union Carbide Co., Texas City, Texas, to Charleston, W. Va. The new boat is the property of Plaquemine Towing Co., headed by Capt. J. W. Banta and named for one of his sons. It was built by the Avondale Marine Ways, New Orleans, La. She is speedy, smooth-running and, like so many southern boats, has a high pilot house. Of all-welded steel construction, the vessel is 99 by 30 by 10 feet in dimensions and will be eventually devoted, it is said, to the petroleum products trade.

In addition to its strictly utility features, the boat has all that is ordinarily expected of modern towboats in the way of comfort and livability. The cabin is arranged to accommodate 13 persons and there is abundant space for handling the office details. The *George W. Banta* is powered by twin General Motors engines, developing 1800 hp., with Falk reduction gears. Two vanadium steel F-design rudders, 4-blade Avondale type, 74 inches in diameter are used. The steering gear is of Avondale's own design. Ingersoll-Rand air motors, RCA radar, RCA radio-telephone, Kahlenberg air horn, Carlisle-Finch searchlights, Gould's and Viking pumps, Quincy compressors, Pelham switchboard and Michiana filters are included in the equipment list.

Since the boat has faced the stern realities of canal-river traffic in all kinds of weather, the builders and the owning company agree that the results are all that could be expected.

Airless Blast Machine Bulletin

Blast cleaning by airless means in a tumble-type machine is the subject of a new bulletin published by American Wheelabrator & Equipment Corp., Mishawaka, Indiana. The booklet describes advantages of the airless blast cleaning process with specific reference to the 11½ cu. ft. capacity Tumblast model in the company's line.

The unit is intended for high production cleaning of castings, forgings, heat-treated parts, weldments, die castings or stampings, to name a few of the range of applications. Free copies of the bulletin, No. 114-B, may be obtained by writing American Wheelabrator & Equipment Corp., 1784 South Byrkit St., Mishawaka, Indiana.

Midget 4-Way Solenoid Valve

A new, compact Midget 4-Way Solenoid Valve standing only 4½ in. high with an over-all length under 3 in. and depth of 2 in. is being marketed by the Automatic Switch Co. of Orange, N. J. Permissible pressures range from a minimum of 10 lbs. to a maximum of 125 lbs. for ac., and up to 50 lbs. for dc. Pipe size is ¼ in., orifice diameters are ⅜ in. inlet, ⅝ in. exhaust. Power consumption is 10 watts. The valve is designed for handling air, water, light oil and other non-corrosive gases and liquids at temperatures up to 212°F.

The valve is designed primarily for controlling small double-acting cylinders, and is also used to control two single-acting cylinders where pressures must be alternately applied and exhausted. Valve bodies are of forged brass to insure freedom from porosity. Valves are packless with integral crown seats and resilient and nylon discs suited for tight seating requirements. All metal parts in contact with the fluid are either brass or stainless steel to reduce the possibilities of corrosion. Further information may be obtained from the Automatic Switch Co. by requesting Bulletin 8345.

Worthington Subsidiary Company Opens

Worthington Corporation announces the recent establishment of a new subsidiary, Worthington Limitada, in Bogota, Colombia. Other Worthington Corporation Latin American subsidiaries are located in Mexico, Argentina and Brazil. Mr. S. R. Williams, Worthington Corporation vice-president in charge of foreign business says, "The new Bogota subsidiary is another milestone toward Worthington's goal to bridge the distance between our headquarters here and expanding markets abroad. By operating locally, Worthington can better understand the problems and needs of both its distributors and customers and, in the final analysis, give better service." Worthington Limitada will be managed by Mr. Charles Gorham.

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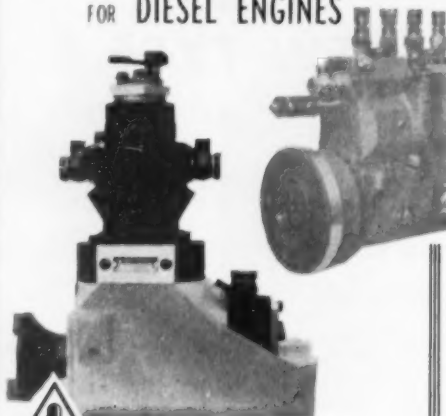
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U. S. Army Tug



One of the new Army tugboats being built by Rawls Bros. of Jacksonville, Florida, on its trial run, powered with a direct reversible 600 hp. Atlas diesel engine.

Power packed with a direct reversible 600 hp. Atlas diesel engine these new tugboats being built by Rawls Bros. Inc. of Jacksonville, Fla., are expected to give a good account of themselves in either harbor or coastwise service. The vessels are of all steel construction, welded throughout and designed with berthing and eating facilities for a crew of six. All nine vessels will have the following dimensions: length overall 70 feet, weight 122 long tons. The Model 45-M5X-8 Atlas diesel engines were supplied by the National Supply Company; with Capital 2.5:1 reduction gears, also in the engine room are two Nordberg 4 FS 2-AE diesel generating sets of 10 kw. each and 2 Quincy model D325 air compressors.

At 12 knots speed their range is 2100 nautical miles and at 9 knots they are expected to cover a distance of 4800 nautical miles. The sea trials on the first tugboat shows that they are highly maneuverable. It was delivered to the Army Transportation Corps depot at Charleston, South Carolina and the remaining 8 tugs are scheduled for delivery at the rate of two a month.

Caterpillar Plans New Building

Plans for construction of a new building to furnish improved office facilities for its engine division have been announced by Caterpillar Tractor Co. The project, to be ready for occupancy early in 1955, will house the entire division's office activities under one roof closer to the point of manufacture at Peoria, Ill.

New Quincy Safe-Q-Lube System



New Quincy safe-Q-lube system increases dependability of Quincy pressure lubricated compressors. Safe-Q-lube when used in conjunction with Quincy patented loadless starting automatically unloads the compressor when the oil level runs low. Lack of air signals the operator to add oil before bearings are damaged. The new Quincy safe-Q-lube also operates Quincy's patented loadless starting and reduces the number of parts by 62%. Fewer parts mean lower maintenance. With safe-Q-lube, loadless starting can now be added to Quincy Compressors in the field. For further details, write Quincy Compressor Co., Quincy, Illinois.

Cooper-Bessemer Branch Office

Opening of a branch office in Minneapolis, Minnesota has been announced by the Cooper-Bessemer Corporation of Mount Vernon, Ohio, through Stanley E. Johnson, vice president and director of sales, and Charles L. White, district manager.



R. B. Scott

R. B. Scott will be in charge of the branch. Mr. Scott has had wide experience in sales engineering, having spent 17 years in that field in the upper Midwest area. He is a graduate of Worcester Polytechnic Institute and is a member of various engineering organizations. Mr. Scott has been president of the Minneapolis Engineers' Club.

The new Cooper-Bessemer office will cover the Minnesota area and the rapidly developing oil and gas field in North Dakota and South Dakota as well as municipal and industrial power needs.

Increases Plant Capacity



In order to provide better and faster service to West Coast customers, Aero-Coupling Corporation, at Burbank, California, a subsidiary of Aeroquip Corporation of Jackson, Michigan, has increased plant capacity by a new addition totaling 5400 square feet. The company supplies Aeroquip flexible hose lines with detachable, reusable fittings for conveying all kinds of fluid, as well as self-sealing couplings, "Breakaway" couplings and brazed aluminum elbows for aircraft, industrial, automotive, construction equipment and farm applications. According to G. G. Bell, Aero-Coupling general manager, the new plant area houses brazing facilities enabling Aero-Coupling to furnish its customers with exceptionally fast delivery on short-run items and sample parts. Also included are new warehouse facilities and a modern "non-profit" cafeteria for the employees.

Names Chicago Area Distributor

Appointment of Power Transmission Equipment Company, 1245 West Fulton St., Chicago 7, Illinois as an exclusive Chicago area distributor of Morse mechanical power transmission products was announced recently by R. J. Howison, vice president-sales of the Morse Chain Company. Power Transmission Equipment Company, one of the largest distributors of mechanical power transmission equipment in the country, will be an exclusive Morse Chain distributor in 21 Illinois counties and six Indiana counties in the Chicago and adjoining industrial areas, Howison explained.

Open House Marks Expansion



An open house marked the formal opening of Chain Battery & Automotive Supply's new \$200,000 building in Shreveport, Louisiana, recently. Some 2,000 visitors toured the new plant, the third location of Chain Battery in Shreveport since its founding 35 years ago. The new, modern building is located in downtown Shreveport at Spring and Fannin Streets and features a paved parking area of 15,000 square feet for the added convenience of Chain Battery's many customers. The building itself contains more than 36,000 square feet of floor space. Chain Battery's growth has paralleled that of Shreveport and the great Ark-La-Tex area which it serves.

It was founded in 1919 as a small battery manufacturing plant when Shreveport's population was less than 44,000. Chain Battery bought the manufacturing rights and assets of the Southern Battery Company of Shreveport in 1920 and continued an amazing growth in the early 20's when it expanded into the automotive parts business. Charles B. Grayson, who went to work for the company in 1923 and became its president in 1937, was primarily responsible for the company entering the automotive parts field as he envisioned the tremendous potentialities in that aspect of the business. He headed the company until his death in February, 1946, and his widow, Mrs. Velma Grayson, continued to follow the progressive policies he set down from then until now. In recent years most of the growth and progress of the company has been under the direction of Sam B. Grayson, Charles Grayson's son, who serves the firm as vice-president and general manager.

Part of the old Henderson building is incorporated in the new building for Chain Battery, which is one of the largest automotive parts warehouses in the south. In the completed building, 2,000 square feet of floor space are devoted to the office section; 2,000 square feet are used for the show room and parts counter; 26,000 square feet for the parts room and 6,000 square feet for the shop.

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Effective Vibration Control

Actual on-the-job photos and case histories showing how representative diesel and gas engine vibration problems have been solved with effective vibration control are included in a new catalog available without charge from The Korfund Co., Inc., specialists in vibration control for over half a century. The installations featured range in size from a 16 hp. diesel generator set on a truck up to a series of six 1425 hp. supercharged diesels at a power plant. Catalog PS-4 shows why vibration-free installations are now possible in critical locations such as hospitals, telephone offices, apartment and office buildings, radio stations or on truck, railroad or ship installations where Korfund Vibro Isolators also prevent engine distortion due to twisting of the sub-base.

How to select the proper isolating medium is an important consideration treated in the new literature. Steel spring Isolators provide the most efficient method of isolating vibration, approaching 100% in effectiveness. Rubber and cork, when properly applied, provide very good low cost vibration and noise control for non-critical installations. For a free copy of catalog PS-4 or for more detailed information, write to The Korfund Co., Inc., 48-20B 32nd Place, Long Island City, N. Y.

High Velocity Steam and Air Exhaust Silencers

A new line of high velocity steam and air exhaust silencers, designed to set new standards in noise control in critical and non-critical areas, has been developed by the Burgess-Manning Company, pioneer manufacturers and inventors of industrial noise abating devices. The new line is known as Series "ADS" Acoustic Discharge Silencers. They are designed to eliminate high and low frequency noises caused by high velocity discharge from steam and air devices. The new silencers operate on the patented Burgess-Manning snubbing principle and employ especially designed acoustic reactance chambers plus special sound absorbing material.

The new silencers are for use on steam vents, steam safety valves, hogging jets, gas turbines, air nozzles, evacuating ejectors and similar devices discharging high velocity steam and air into the atmosphere. Series ADS will be available in three models: ADSO for optimum silencing in critical areas; ADSS for the type of silencing required in semi-residential and light industrial areas; and ADSC for commercial silencing in non-critical areas. All models will be available in standard 8 to 30 inch pipe size, but special sizes are available upon request. Series ADS is described in Bulletin No. 265 which may be obtained from Mr. H. A. Dietrich, sales manager at Libertyville, Illinois.



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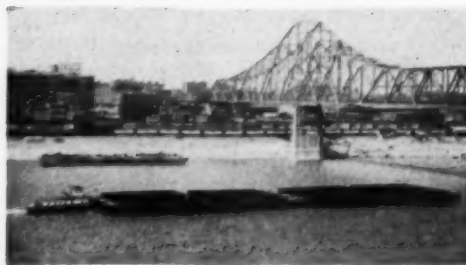
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Integrated Sand and Gravel Tow



Shown on the delivery trip to St. Paul is the new twin
screw towboat *Joeljim* with its fleet of sand
and gravel barges. The towboat is powered by Caterpillar
D375 diesels.

The new 540-hp. twin screw towboat *Joeljim*
and its fleet of 12 integrated sand and gravel
barges, designed and built by the St. Louis Ship-
building & Steel Co., recently were delivered to
the J. L. Shiely Company, Inc., St. Paul, Minne-
sota. The towboat is powered by Caterpillar D375
diesels, each rated at 270 hp. at 1,000 rpm. The
normal tow will consist of four integrated sand
and gravel barges, each 100 by 30 by 8 ft., with a
cargo capacity of more than 500 tons each.
This new integrated sand and gravel fleet, the first
built on inland waterways, will be used by the
Shiely Company to transport sand and gravel from
its plant at Grey Cloud to St. Paul.

Joins Cummins Service and Sales

J. L. Oneal, formerly re-
gional service manager for
the Cummins Engine Com-
pany, has joined the sales
staff of Cummins Service
and Sales, Los Angeles, ac-
cording to J. R. Neal,
general manager. He is a
veteran, having been a
diesel specialist with the
Navy in the South Pacific
during the last war. For nine years he was field
service representative for the factory, for three
years regional service manager for the Rocky
Mountain Division with headquarters at Denver,
Colorado. For more than two years he was regional
service manager for the Cummins Engine Com-
pany in Los Angeles before becoming a representa-
tive for Cummins Service and Sales, Cummins
Engine dealers for Southern California.



J. L. Oneal

Heads Harnischfeger Division

A new division has been
established by Harnisch-
feger Corporation, Mil-
waukee, to handle sales of
P&H electrical equipment.
Named to head this new
division is Oliver Fuller,
formerly of P&H Welder
and Excavator Manufac-
turing, Escanaba, Michi-
gan. Mr. Fuller joined



Oliver Fuller

Harnischfeger Corporation early in 1946 after four
years' experience in sales and engineering with a
large manufacturer of electric controls. His back-
ground in this field also includes electrical engi-
neering at Cornell University. While the creation
of this new division to handle the distribution of
its electrical products represents a further expan-
sion of the company's activities, it does not mean
P&H is a new manufacturer in this field. Harnisch-
feger has been a consistent producer of electrical
products since 1897 and is noted for its many
developments in this field, such as the Magne-
torque electrical clutch. Some of the products to
be handled by the new Electrical Sales Division
include AC and DC motors, motor generator sets,
bare generators, magnetic and hydraulic brakes,
controllers, limit switches, etc.

An important product of this division, and now
offered to other equipment manufacturers for the
first time is the P&H Magnetorque electric brake
and drive which provides smooth, lasting service
without any maintenance of the Magnetorque unit
whatsoever. Braking or driving action is electro-
magnetic—there are no friction linings. Literature
describing the complete line of P&H electrical
equipment is available. Write Harnischfeger Cor-
poration, Electrical Sales Division, 4400 W. Na-
tional Ave., Milwaukee, 46, Wis., for Bulletin EM-1.

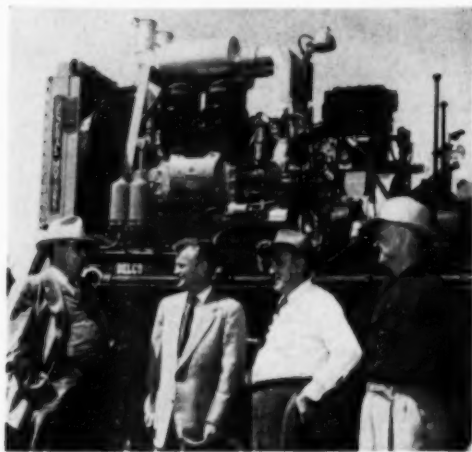
Two More From Florida

Florida Diesel Engine Sales Co. packaged two more
trawlers for the shrimping industry when the newly
built *High Noon* and *Dream Girl* were launched
recently in St. Augustine. Built with top workman-
ship, both vessels are 67 by 18 and designed by
Tams. Powered with General Motors 6-110 diesel
engines rated at 190 hp. with GM 4.1:1 reduction
gears and GM clutches driving a 4-blade 50 by 44
Columbian propeller, their speed was 11 knots on
the trial runs. Miller Bros. of St. Mary's, Ga., are
the owners of *Dream Girl* while Adolph Brooks of
the *High Noon* has Brownsville, Texas, as his home.



Dream Girl, owned by Miller Bros. of St. Mary's, Ga.,
has an Onan generating set and a GM 6-110 diesel.

Heavy-Duty Rigs Step Up Servicing



Pictured with acidizing and fracturing rig driven by GM series 71 twin-6 diesel are (left to right) W. S. Day, Michigan district manager for Dowell, Inc.; E. J. Echols, development engineer of Tulsa; D. Wyman, station manager; and H. Marsh, service manager.

Servicing facilities of Dowell, Inc. in Michigan oil fields were stepped up recently when two of the company's heavy-duty acidizing and fracturing units were delivered to stations in Mt. Pleasant and Reed City. E. J. Echols, development engineer for Dowell at Tulsa, followed the units to Michigan and helped local station personnel make the first treatment using the equipment.

The units sent to Michigan are mounted on semi-trailers and each consists of a Dowell Triplex DR-E pump driven through a Fuller 10-speed transmission by a General Motors series 71 twin-6 diesel engine. Company spokesmen report that each unit can pump one barrel of fracturing materials a minute at 10,000 lbs. pressure. Mixing tanks operated by hydraulic motors from power supplied by the diesels are also mounted on the trailers. The entire units, including tractors, are only 45 feet in overall length and weigh 49,000 lbs. each. The weight is carried by dieselized tandem-axle tractors and semi-trailers.

Rheostat Bulletin

The Herman H. Sticht Co., Inc., has recently issued Bulletin No. 551 which shows their complete line of Standco Slide Wire Rheostats with graduated percentage scale. Of particular interest are the new type double rheostats shown which are suitable for series or parallel connection and are designed to cover a particularly long range in resistance, and have a large amount of current capacity. Also shown are fixed resistors—potentiometers with one or more adjustable band. The graduated percentage scale which is attached to all rheostats has a feature which enables the user to calculate approximate resistances very quickly and to vary the resistances and current intelligently. For a copy of Bulletin No. 551, write The Herman H. Sticht Co., Inc., 27 Park Place, New York 7.

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Metallurgist Wins Seaman Medal

For his "outstanding work in the development and dissemination of engineering data on the production and utilization of alloy cast irons," Thomas E. Eagan, chief metallurgist of the Cooper-Bessemer Corporation, Mount Vernon, Ohio, has been awarded the Joseph S. Seaman Gold Medal by the American Foundrymen's Society. Formal presentation of the award was made during the annual banquet of the society at its 58th convention in Cleveland. F. J. Walls is chairman of the board of awards.



Thomas E. Eagan

As chief research metallurgist for Cooper-Bessemer, Mr. Eagan has paced the company's development programs in high strength irons and, more recently, in the perfection of techniques for casting nodular iron in the production of high pressure vessels and engine and compressor components. He is a graduate of Columbia University and the Missouri School of Mines and Metallurgy and has been affiliated with Cooper-Bessemer since 1934.

Mr. Eagan, a past national director of the American Foundrymen's Society, is a member of American Institute of Metallurgical Engineers, American Society for Metals, American Society of Testing Materials, Society of Automotive Engineers and British Iron and Steel Institute.

Named General Manager



S. K. Hostetter, Jr.

S. K. Hostetter, Jr., sales manager of Elliott Company's Crocker-Wheeler Division for the past year, has been named general manager of the division. Mr. Hostetter joined Elliott Company in 1934 after his graduation from Pennsylvania State University. Before going to the Crocker-Wheeler Division he had been in the company's Washington office, first as a field engineer and then as district manager for ten years.

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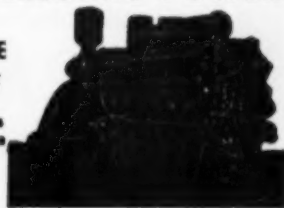
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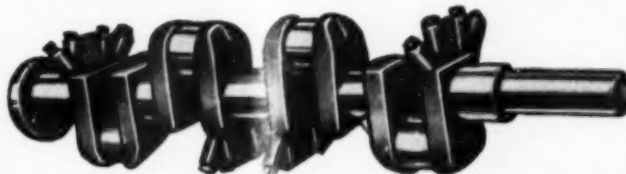


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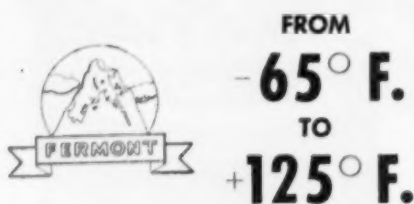
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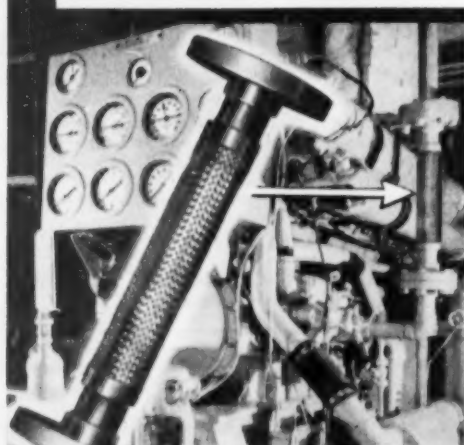
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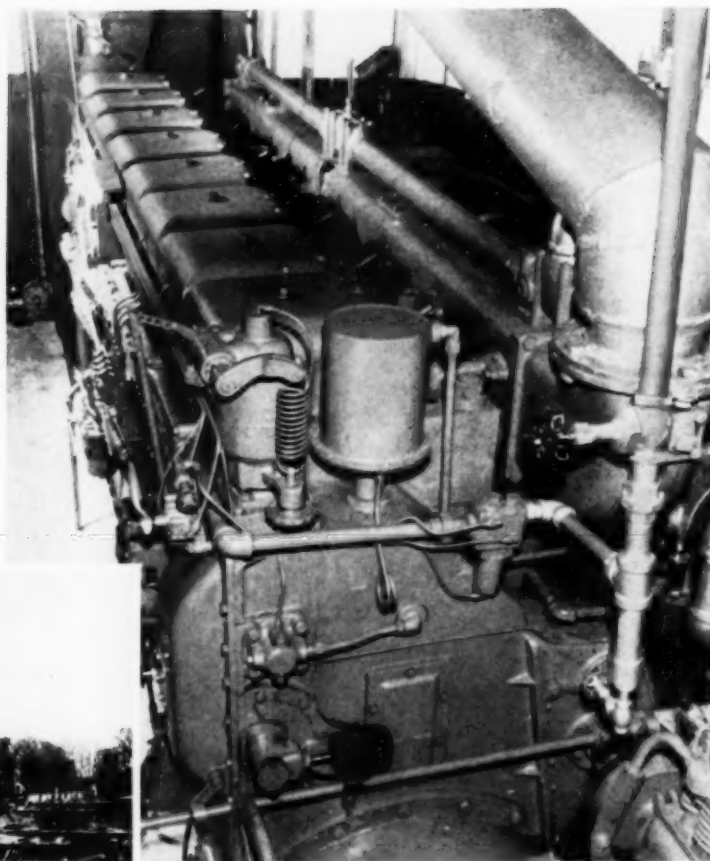
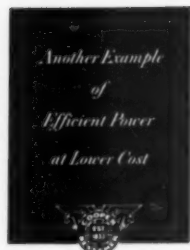
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